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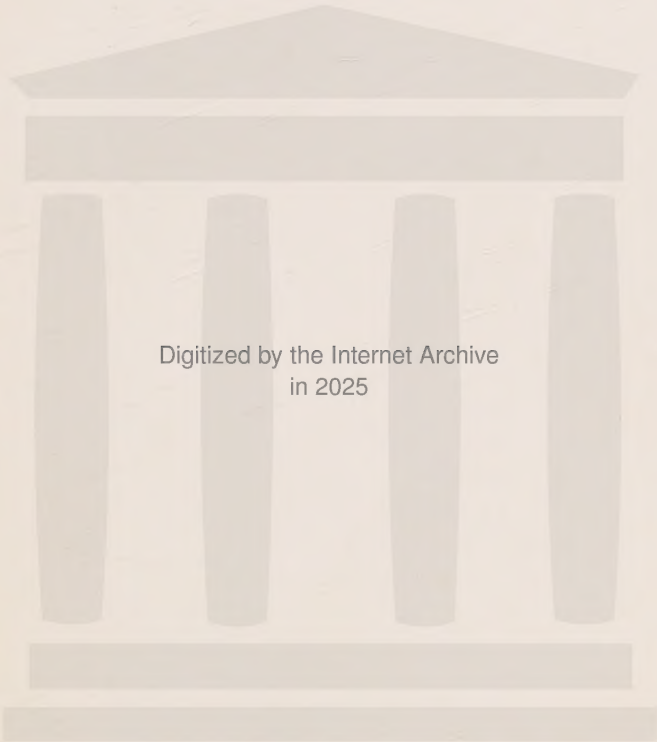

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No. 1. General View of Research Station, showing additions in 1923.

From left to right: Orchard House and Preparation Room (1923-4), Propagation House and Fumigation Chamber (1923-4), Packing and Spraying Sheds (1920), Oast House (1922), Stabling and Old Laboratory (1914) (now Pathological Laboratory), Staff Annexe and Caretaker's Cottage (1923-4), and Physiological Laboratory, Library and Offices (1921).

THE KENT INCORPORATED SOCIETY
FOR PROMOTING EXPERIMENTS
IN HORTICULTURE

ANNUAL REPORT

EAST MALLING
RESEARCH STATION

1st January, 1923, *to* 31*st December,* 1923

COMMITTEE OF MANAGEMENT, 1923.

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Appointed by the Kent County Council:

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Appointed by the West Sussex County Council:

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*J. D. MAXTED, Esq., Newlands, Teynham, Sittingbourne, Kent.

W. R. ELGAR, Esq., Sittingbourne, Kent.

Appointed by the Research and Advisory Committee, S.E.A. College, Wye:

*Professor V. H. Blackman, Sc.D., F.R.S., F.L.S., Imperial College, South Kensington, London, S.W.7.

*E. S. SALMON, Esq., F.L.S., The College, Wye, Kent.

Appointed by Long Ashton Horticultural Research Institution:

*Professor B. T. P. BARKER, M.A. (Director), (*ex-officio*), Long Ashton, nr. Bristol.

Appointed by The John Innes Horticultural Institution:

Professor W. BATESON, M.A., F.R.S. (Director), (*ex-officio*), Merton, Surrey.

Appointed by Cambridge University Horticultural Research Station:

*Professor R. H. BIFFEN, M.A., F.R.S., School of Agriculture, Cambridge.

Appointed by the National Farmers' Union (Kent Branch):

B. CHAMPION, Esq., Baron's Place, Mereworth, Kent.

*W. COLTHUP, Esq., Harbledown, Canterbury, Kent.

The Kent Incorporated Society for Promoting Experiments in Horticulture

IMPERIAL BUREAU OF MYCOLOGY
30 SEP 1924

ANNUAL REPORT

EAST MALLING RESEARCH STATION

EAST MALLING
KENT.

1st January, 1923, to 31st December, 1923

Price Non-Subscribers 3/-
plus postage 4d.

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G. Miller, Esq., Pine Ridge, Orpington, Kent.
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*J. M. Robertson, Esq., Belluncle, Hoo, Rochester, Kent.
*W. Rogers, Esq., Court Lodge, Horton Kirby, Kent.

Appointed by the Horticultural Trades' Association:

*E. A. Bunyard, Esq., F.L.S., Allington Nurseries, Maidstone, Kent.

Appointed by The Institute of Brewing:

The President, The Institute of Brewing, Brewers' Hall, Addle Street, London, E.C.2.
*Arthur Landauer Stern, D.Sc.(Lond.), Research Department, Institute of Brewing.

Associate Member:

M. J. R. Dunstan, Esq., M.A., O.B.E., F.R.S.E., F.I.C., Principal, Royal Agricultural College, Cirencester.

* Denotes Members of Executive Committee.

STAFF:

Director: Ronald G. Hatton, M.A. (Oxon.).
Pomology: R. G. Hatton.
N. H. Grubb, M.S.A. (Cornell).
J. Amos (Manager Recorder).
A. W. Witt (Propagator and Recorder).
H. M. Tydeman (Assistant Recorder).
Miss A. D. MacKenzie, Dip: Hort: Sci: (Oxford and Reading) (in charge of Records) (appointed 1–1–24).
Pathology: H. Wormald, D.Sc. (Lond.), A.R.C.Sc.
Entomology: A. M. Massee, F.E.S.

The Kent County Council Horticultural Adviser—Mr. N. B. Bagenal, B.A. (Cantab.)—has an office at the Research Station.
Secretary: Miss M. K. Glover.

JANUARY to DECEMBER, 1923.

Since our Annual Report is intended to keep all those interested in our work in close touch with the development of the Station and progress of the experiments, it is proposed to maintain it, at least for the present, in the form given to it last year.

Section I. will deal with general developments and activities.

Section II. will describe the development of the farm and the manner in which it is laid out in experiments. This year a detailed plan and guide of the original twenty-two acres, Great East Field, is given.

Section III. will be a summary and report of progress concerning individual items on the general programme of work. This section will not be used for giving exhaustive accounts of work which is arriving at a mature stage. Other publications exist for this purpose.

Section I.

GENERAL DEVELOPMENT AND ACTIVITIES.

Completion of Building Scheme.

In the last report an appeal was made in which Growers were asked to raise the sum of £2,800 in order to earn the grants promised from the Development Fund for the completion of the much needed buildings.

It is matter for congratulation that, with the exception of £600, the sum has either been promised or actually donated. This has made possible the completion of the first part of the scheme.

A Propagation House, 40 feet by 11 feet, with the necessary equipment for experimental purposes, is now actually in use. To this is attached a small fumigation chamber.

An Orchard House, 90 feet by 24 feet, divided into four sections, the first for general pot culture work, the second an insect proof section for plant breeding, the third and fourth greenhouse laboratories, equipped for Plant Pathology and Entomology, and for Plant Physiology, is practically ready for occupation. A small preparation room, where gas can be used, soil sterilised, etc., is attached to the Orchard House.

The building planned as a Caretaker's Cottage, with an Annexe for additional Staff rooms, should be completed early in 1924.

The old Laboratory and Office, for some years occupied by the Recording Staff, has been equipped as a Pathological Laboratory and Culture Room. Until the above-mentioned Annexe is completed the recording Staff are without proper accommodation.

The Executive Committee, however, were required by the Ministry of Agriculture to give a guarantee that the whole contribution (£2,800) should be forthcoming from non-government

sources. The Committee have then still to raise £600 in order to complete the scheme and allow of the erection of another much needed dwelling house. With the increase in the Staff at the Station, the housing problem, already difficult in a remote situation such as ours, is becoming insoluble.

With the development of the Station such new problems are bound to arise not infrequently.

Annual Maintenance Grants.

As foreshadowed, the Grants from the Ministry of Agriculture permitted the appointment of two additional members of Staff, but they do not unfortunately allow of much needed increases in the recording and administrative Staff.

The single grant of £200 voted last year by the Kent County Council and used for the Maintenance of the Field Trials, has, this year, been converted into an annual grant for a further period of five years.

A single grant of £100 has been voted by the East Sussex County Council in respect of the current financial year.

The help of such grants is extremely welcome and it is hoped that they may allow of the extension of activities in important directions, which would otherwise be impossible.

Committee of Management.

The Committee of Management has welcomed Dr. Arthur Landauer Stern, of the Research Department of the Institute of Brewing, upon its Executive Committee, otherwise the body remains unchanged.

It was with universal regret that the Committee accepted the resignation of Mr. J. H. Gill as Solicitor to the Society. He had been connected with the affairs of the Station throughout.

Staff.

Dr. H. Wormald came to East Malling as Pathologist in October, 1923. It was of special advantage to the Station to secure the full-time services of Dr. Wormald, since it simplified the conduct of certain lines of work in which he had previously collaborated, whilst at Wye. He brings with him the goodwill

of that Institution, and it is felt that his advent will go to strengthen the ties already existing.

Mr. A. M. Massee, who had been working at East Malling for the past two years as a Research Scholar of the Ministry of Agriculture, has remained with us to pursue his Entomological Work.

The activities of these two workers will help to relieve the Pomological Staff from spending an undue proportion of their time on lines of work not directly within their province, but constantly obtruding themselves.

Mr. N. B. Bagenal, the Horticultural Adviser for the County, has been able to collaborate with various members of the Staff in the conduct of spraying experiments in the field, designed to check Experimental results obtained here. He has also undertaken to report upon the Soft Fruit variety trials being conducted on different soils in the County, and to keep an eye upon the similar root stock plots.

Of our three Assistant Recorders, two, Miss K. P. Worsley and Mr. T. N. Hoblyn, have left us for other occupations. So far their positions have not been filled, but we are hoping early in the New Year to obtain the assistance of Miss MacKenzie, formerly of the Ministry of Agriculture, to take charge of the records that are now accumulating in such quantity, and to assist in actual recording.

Even our closest supporters do not fully realise what the keeping of individual tree and bush records entails. After the first three or four years, measurements of growth alone may amount to as many as 120 entries per tree. In the realm of field experimentation it is only by weighing up such statistical records on a considerable number of trees that it is possible to give an accurate indication of the results of any treatments that may be under trial.

Such records are actually being kept on the Station alone for some 4,000 trees, which increase the obligation annually at compound interest. If this most valuable side of the work is to be maintained, some permanent additions to the recording Staff will be essential.

At the present time two post-graduates are making special studies at the station and gaining experience as to the conduct of experimentation in the field by assisting in recording.

Mr. E. Ball, B.A. (Cantab.), is studying the non-setting of plums, and Mr. R. Harris, B.Sc. (Imp Coll.), is working on Raspberry diseases.

COLLABORATION.

(*a*) *Plant Physiology.* Dr. R. C. Knight, D.I.C., of the Plant Physiological Department of the Imperial College of Science, is still pursuing his investigations at East Malling into the problems raised by the Root Stock Work. He is also collaborating with members of our Staff on the work concerned with methods of Vegetative Propagation, and with "Reversion" of Black Currants.

(*b*) *Hop Investigations.* Mr. E. S. Salmon, F.L.S., has, as usual, been directing the trials of his seedlings against commercial varieties of Hops.

Mr. A. H. Burgess, B.Sc. (Agric :) of the Chemical Department of the S.E.A. College, Wye, is analysing the hops grown at East Malling for their resin content, under a grant from the Institute of Brewing. He is also advising East Malling, from a chemist's point of view, upon the Hop Manurial Experiments.

The Station is also indebted to Dr. Arnaud, F.I.C., County Analyst, for making the many analyses of the manures applied, and also for making soil analyses on various plots.

Mr. F. Cheal, N.D.A., has, under the direction of Mr. Salmon, and Prof. V. H. Blackman, and with a special grant from the Ministry of Agriculture, been investigating in the field the incidence of "Mosaic" Disease of Hops at East Malling, as well as in commercial gardens.

(*c*) *General Pomology.* The joint work between Mr. G. S. Peren, of Long Ashton, and East Malling, in relation to the nomenclature and subsequent trial of raspberry varieties, has been actively pursued.

(*d*) *Genetic Work.* Mr. M. B. Crane, of the John Innes Horticultural Institution, Merton, is raising seedlings from certain of the East Malling stocks with a view to studying their genetic constitution and the possibility of combining desirable characters of different varieties.

These seedlings are being propagated vegetatively at East Malling and tested for their root-stock suitability. The joint work designed to test the value of stock influence in hastening the maturity of seedlings is continuing.

Mr. Crane has also given us the benefit of his experience in our Black Currant breeding work.

(*e*) *Pathological Investigations.* Mr. F. T. Brooks, M.A. (Cambridge University) has recently published in the *Journal of Pomology* (Vol. III., No. 3, Sept., 1923), some of the results of his tests of the East Malling Plum Stock Varieties for resistance to Silver Leaf. He is testing one or two further varieties for us, and is continuing his investigations upon a number of Victoria Plum Trees worked upon known root systems. The joint work on the methods of control of the disease in the Nursery and Plantation is progressing.

Mr. E. S. Salmon and Dr. W. Goodwin, of the S.E.A. College, Wye, and Mr. N. B. Bagenal, are all collaborating with us in testing and developing, under field conditions, the results of our early trials of Fungicides on Apples.

Dr. Goodwin and East Malling are also working in an advisory capacity with Mr. Bagenal in testing certain winter insecticides.

Mr. L. N. Staniland, A.R.C.S., of the Imperial College of Science, has published a paper in the *Journal of Pomology* (Vol. III., No. 2, April, 1923), indicating the degrees of resistance to Woolly Aphis of the East Malling Apple Stock Types. Joint work is being continued along several lines.

Certain immune varieties of Apple are being raised vegetatively for testing as stocks; the mutual influence of the stock and scion on resistance is being investigated; and certain of Mr. Crane's new seedlings are being infected to test their degree of resistance.

It will be understood that the collaborated lines of work with Dr. Wormald and Mr. A. M. Massee were continued as outlined in the previous report up to the time of their appointments on the Station Staff.

Outside Trials.

With the accumulation of recording work upon the Station itself, it is becoming increasingly difficult to keep detailed records of these trials. However, they are felt to be such an important complement to our results here that an attempt will be made to continue detailed observations for at least another season. In several instances it has been possible to interest the County

Horticultural Staffs in these trials, and this may prove to be one solution of the difficulty.

Two additional Kent Growers have offered suitable areas of land for extending the root stock, pruning and soft fruit trials. These offers were accepted, and we have been thus enabled to plant the first considerable duplicate trial of Pears on various Quince Stocks, and to test some of our Apple Stocks under Weald of Kent conditions.

The distribution of sets of black currant varieties has extended considerably. In East Sussex, Mr. W. Goaring, the County Horticulturist, has placed four trials for us and has agreed to keep them under observation. In addition, a number of growers in different counties have agreed to send in annual reports of crop weights on the experimental bushes supplied.

Advisory Work.

Despite the advent of Mr. Bagenal, to whom it was possible to refer some of the general advisory enquiries, the Pomological Staff have again dealt by letter with some 400 enquiries. As before, many of these queries were accompanied by specimens of Stocks, Raspberries and Black Currants for identification.

The two new members of Staff have, in addition, already begun to deal with the enquiries relating to their subjects.

The telephone is becoming more popular than ever as an additional instrument of enquiry, and many Kent Growers continue to seek verbal advice in this way.

Mr. Bagenal has been able to pay a considerable number of visits on behalf of the Station, and so deal on the spot with many enquiries which would otherwise have necessitated correspondence. Members of the Station Staff have, however, paid some forty advisory visits during the year. There is a notable increase in the demand for such visits from East and West Sussex, and wherever possible these have been complied with.

Visitors.

The names of 789 visitors, who came to see the general work of the Station, during the year, are recorded. Few large parties were entertained, and these visits were spread over not less than 133 days. This gives some idea of the calls upon the Station's Staff. Mr. Bagenal is now becoming familiar with the Station

and has been able to take charge of several parties. Arrangements have been made whereby, in the forthcoming year he will be at the Research Station on Tuesdays –one of the two visiting days—to receive Kent Growers.

Several Advanced Students from the S.E.A. College, Wye, and from Cambridge University, have spent varying periods on the Station for the purpose of gaining experience, and students from Wye and Swanley Colleges have paid periodic visits as usual.

Conferences.

In February, Mr. Grubb gave a two days' pruning demonstration at the Station. Despite the fact that the weather was exceedingly bad, some eighty growers and tree cutters attended. The outside demonstration was supplemented by lantern lectures, given by Mr. Bagenal.

On July 4th, members of the Horticultural Trades Association paid their Annual informal visit, with the particular object of discussing varieties of small fruits. On the following day, a Conference on Small Fruits arranged jointly by Wye College and ourselves, with the object of bringing together the Research Workers the Advisory Officers, and Horticultural Instructors, was held. Mr. W. J. Lobjoit, the Controller of Horticulture, and Mr. H. V. Taylor, Deputy Controller, attended the Conference. Various papers were contributed by County Officers and others, and the discussions were found to be so useful that the general wish was expressed that such a Conference might become at least an annual event.

The London School of Nature Study arranged their September meeting at the Station. Lectures were arranged for the morning session, and the afternoon was spent in inspecting the plantations.

East Malling was represented at the International Horticultural Congress, held at Amsterdam in September, and a member of Staff contributed a paper.

Lectures and Exhibits, etc.

The amalgamation of the various Kent Agricultural Shows and of the District Fruit Shows has been of great advantage to Institutions such as our own. An exhibit, illustrative of a large part of the Station's activities, was staged in the Kent Agricultural

Education Tent at the First Kent County Show, Gravesend, in June.

At the Imperial Fruit Show, Manchester, October 26th-November 3rd, a largely new Exhibit, illustrating the Plum Root Stock and Raspberry Classification work was staged. The Station, as usual, supplied a Judge at the Imperial Show. On both these occasions one or more members of Staff were in attendance during the whole time.

A representative Exhibit was loaned to Mr. Costin, the West Sussex Horticultural Instructor, for staging at the County Show held at Horsham in July.

Mr. Bagenal has been able to lighten the burden of lecturing very considerably within the County. He has most successfully interpreted experimental results of the work at Malling to the farmers.

Members of Staff have actually been called upon to give ten lectures: three in Kent, four in Sussex, one in Berkshire, one in Norfolk, and one at the Imperial Fruit Show, Manchester. A course of lectures was also given at the Rural Teachers' "Refresher" Course held at Cambridge, under the auspices of the Board of Education. It is chiefly through the rural teacher that we shall be able to interest the rising generation of Agricultural workers. Already some of the School Gardens are beginning to demonstrate results of this effort.

Staff Meetings.

The Staff Discussion Meetings, mentioned last year, have now become a recognised part of the winter routine, and are found so valuable that they are now being held more frequently. Certain meetings were devoted to accounts of work given by members of other Institutions. Mr. E. S. Salmon and Mr. F. T. Brooks gave stimulating accounts of their work on Hops and Silver Leaf respectively.

As a result of the very general interest aroused at the Station over questions relating to Plant Physiology, Dr. Knight, with the approval of Professor V. H. Blackman, has been giving an evening course on Elementary Plant Physiology at the Station. The course is a great success and it is a most encouraging sign that several of those engaged in the general operations on the farm have attended voluntarily and regularly.

Other Activities.

Since opportunity offered, in the form of a Travelling Research Fellowship from the Ministry of Agriculture, the Executive Committee sanctioned the visit of the Director during April and May to the United States of America. Some eighteen Research Institutions of the East and Middle Western States were visited, together with the fruit districts of New York State, Michigan, Ontario and Pennsylvania.

The Station has also the additional advantage of the travel experiences of Dr. Knight. With the aid of a grant from the John Innes Horticultural Institution, he paid similar visits in the United States during May and June, to study the application of physiological research to horticulture. It is felt that this personal contact made with many research workers in horticulture must also prove to be of value in the future.

Mr. Grubb for a second year made a tour of the Scottish raspberry areas during his holiday. During the course of the year he also visited many other raspberry districts in pursuit of his classification work.

Mr. Amos and the Director spent several days visiting the Black Currant district of N.E. Norfolk.

The past year has, therefore, been an exceptional one from the point of view of travelling. Considering these and the general activities of the Station, it is to be feared that the attendance of a member of Staff upon the various Committees on which it should be represented, has not been as regular as might be wished.

Section II.

THE FARM.

It is proposed to maintain this section of our report, for keeping those interested in touch with any developments, or particular features of the year's work upon the experimental farm itself, and in giving details of the actual lay out, of the experimental plots, and the varieties and specimens collected upon them.

This year we are giving something in the nature of a complete guide to "Great East Field," the original twenty-three acres. It is hoped, that many of those growers who now make a habit of visiting the plots at least once or twice every season, will find this guide of real value, in helping them to find their way about the grounds. It is also hoped that the lists of varieties grown, etc., will furnish growers with a valuable index to the material which is available at the Station. As opportunity occurs, this guide and list of varieties will be added to and completed for the rest of the Station (Egham Field).

The Fruit Plantations, Nursery and Hop Gardens, were, during the past season, like those of the majority of commercial growers, persistently attacked by various kinds of Aphides (plant lice). Our two-power Spraying machines were in almost continual use from 10th April until 27th July. Without these machines we could not have begun to cope with the epidemic. The Hops and top fruit received eight separate sprayings, and the black currants at least three.

As a result of this constant spraying, we managed with here and there an exception, to keep our trees in good healthy growth, so necessary where future cropping has to be thought of. It was particularly important, that trees upon which such detailed records are being collected, should not have their normal processes interrupted by such disturbing factors. We saved our black currants from the very common defoliation resulting from Aphis attack, and we were able to market a very clean sample of fruit.

During the past season, an attempt has been made to adapt methods of "green manuring" to some of our mixed fruit

plantations. It was felt that the annual dressings of dung and shoddy, might possibly be replaced in certain years, by the ploughing in of a green crop and the addition of less bulky fertilisers. The crops experimented with were Rape, Rye and Trifolium. The Rape and Rye were drilled up the alleys between the trees and black currants during August, so as to avoid later deep digging around the roots of the trees and bushes. Both these crops appear to us worth further trial. Under our conditions the Trifolium does not appear to give sufficient bulk, before the time for the first cultivation arrives.

Four-and-a-half acres of Hops were permanently wired during the season. One half acre remains to be done next Spring.

During the year a small quarry was opened on the farm, where crops had given evidence that the "Ragstone" was near the surface. This proved very useful during the hard weather, and over 100 yards of good stone has been quarried. It is hoped by the time this report appears that our main roadway will have been metalled and rendered passable.

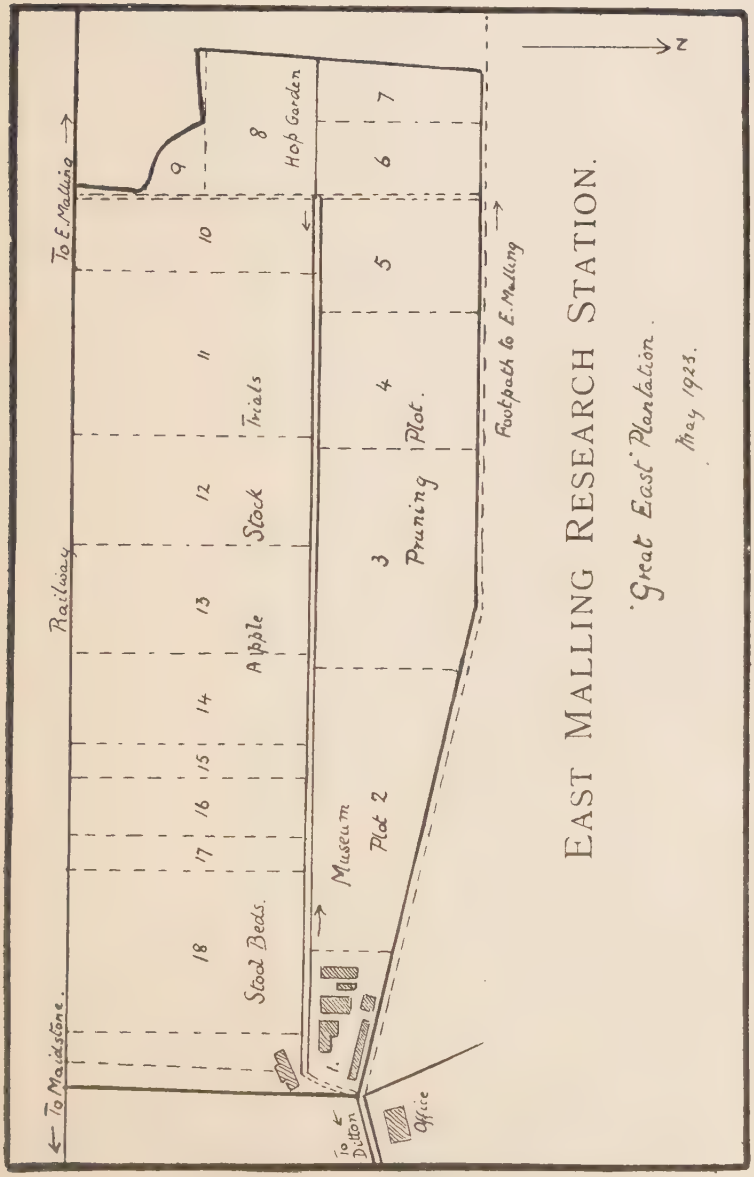
Note Explaining the Labels, etc.

All Plots are labelled from Right to Left. Each Plot is numbered as shown on the Plan.

All plants, trees, etc, are labelled and provided with *Index Letters and Numbers thereon.* The letter denotes the species and the number the variety of that species, e.g.

E56	=	Plum, Victoria
A	=	Apples (Horticultural varieties)
B	=	Pears (Horticultural varieties)
C	=	Quinces
D	=	other Pomaceae.
E	=	Plums.
F	=	Cherries.
G	=	Peaches, Almonds and other Drupaceae.
H	=	Black Currants.
J	=	Red Currants.
K	=	Gooseberries and other Ribes.
L	=	Raspberries and other Rubi.
M	=	Strawberries.
N	=	Hops

PLOTS I TO XVIII.



PLOT I.—This is the area of ground on which the buildings now stand, i.e., Old Laboratory, Stabling, Oast House, Packing Shed, Orchard and Propagation Houses, and site of Caretaker's Cottage and Annexe.

PLOT II. "The "Museum," or Aboretum (1 acre). This contains a varied collection of specimen trees, etc. It includes: Fruiting Stocks—Trees of known pedigree—many forms of Pyrus and Prunus—a collection of plum varieties, some of which are local sorts grown on their own roots—some lesser-known varieties of apple and two rows of Cordon Apples under experiment. The whole is interplanted with Strawberry, Raspberry, Gooseberry and Red Currant varieties.

At the Eastern end of the plot is a small stool and layer bed of selected Cherry Stocks. This is only a temporary position.

PLOT II.

Row 1. Contains specimen seedling Apple Stocks used by Continental Nurserymen as "Crab" or "Free."

Tree 1	A232	Rouge de Trêves (True).
2	A83/40	Seedling from Rouge de Trêves (Luxembourg).
3	A83/122	Seedling from Rouge de Trêves.
4	A214/56	"Crab" Seedling (France).
5	A214/12	"Crab" Seedling (France).
6	A209/7	Seedling from Dutch Apple "Zoete Veen."
7	A209/17	Seedling from Dutch Apple "Zoete Veen."
8	A210/27	Seedling from Dutch Apple "Zoete Bellefleur."
9	A211/7	Seedling from Rouge de Trêves (Holland).
10	A314	Apple Joybells, new Seedling, Taylor (Godalming).

Row 2. Contains wild British "Crabs" and specimens of three species of Prunus.

Tree 1	G14	Prunus spinosa purpurea.
2	E111	Plum, "Mirabelle" (Holland).
3	F15	Morello Cherry (Pedigree Tree).
4	A84/1	Wild "crab" (Hampshire).
5	A84/2	Wild "crab" (Hampshire)
6	A85/1	Wild "crab" (New Forest).
7	A85/2	Wild "crab" (New Forest).
8	D34/1	"Malus sylvestris," Prof. Henry (Dublin).
9	D34/2	"Malus sylvestris," Prof. Henry (Dublin).
10	E133	Bush Plum var. (Harnet).
11	E139	Blue Kroos Plum (Holland).

Row 3. Contains species of Pyrus collected for root-stock and "incompatibility" investigations, and for plant breeding. These are interplanted with Gooseberry, varieties "Brighton (K17) and "Broom Girl" (K14).

Tree 1	D25	Pyrus nivalis var. (Bunyard).
2	D23	Possibly P. nivalis var. (Bunyard).
3	D18	P. nivalis var. (Späth).
4	D29	P. sinensis.
5	D17	P. Michauxii var. (Späth).
6	D30	P. Michauxii var. (Bunyard).
7	D41	P. baccata.
8	D42	P. coronaria.
9	D44	P. cerasifera.
10	D43	P. dioica.
11	D47	P. prunifolia dulcis.

Between Rows 3 and 4 are interplanted Strawberries.

M24	New var. (Edmonds).
M23	Tuckswood Early.
M15	New seedling Hendriksen (Holland).

Row 4. Contains an extension of the collection in Row 3. It also is interplanted with Gooseberries, " Broom Girl " (K14) and " Lord Derby " (K13).

Tree 1	D24	Pyrus communis var. (Bunyard).
2	D23	Pyrus communis var. (Bunyard).
3	D31	P. jaspida.
4	D19	P. pollveria.
5	D26	P. paisha.
6	D20	P. salicifolia.
7	D27	P. elæagrifolia var. (Bunyard).
8	D16	P. elæagrifolia var. (Späth).
9	D32	Possibly P. sinaica (Bunyard).
10	D28	P. sinaica var. (Bunyard).
11	D21	P. sinaica var. (Späth).

Between Rows 4 and 5 and in Row 5 are the following Strawberries :

M21	Victory.
M19	Laxton's Tit Bit.
M17	Laxtonian.

Row 5. Contains a further extension of the collection in Rows 3 and 4 and two species of Prunus.

Tree 1	D38/1	P. Malus toringo seedling (Japan).
2	D38/3	P. Malus toringo seedling (Japan).
3	D38/4	P. Malus toringo seedling (Japan).
4	D38/5	P. Malus toringo seedling (Japan).
5	D37/1	P. Malus prunifolia seedling (Japan).
6	D37/6	P. Malus prunifolia seedling (Japan).
7	G18	Prunus pumila (Japan).
8	G25	Prunus pumila depressa var. (Kew).
9	D45	P. ringo var. (Späth).
10	D46	P. riversii var. (Späth).
11	D48	P. floribunda purpurea var. (Späth).

In Row 5 are planted Gooseberries :

K23 Bobby.
K24 London.
K25 Trumpeter.
K26 Companion.

Between Rows 5 and 6 and in Row 6 are the following Strawberries :

M22 Sir D. Haig.
M20 Lord Beatty.
M16 Marshal Foch.

Row 6. Contains species of Prunus, varieties of Plum and three varieties of Apple, from which root stocks used to be obtained by cuttings.

Tree 1	A93	Oslin Apple.
2	A94	Kentish Codlin.
3	A95	Genet Moyle.
4	G16	Prunus podgoritza Dr. Durham (Montenegro).
5	E83	Kent Bush Plum var. (Bunyard).
6	E94	Unidentified Blue Plum.
7	E95	Early Mirabelle.
8		
9	G21	Prunus padus var. (Hillier).
10	G17	Prunus triflora (Japanese Plum).
11	G24	Prunus virginiana.

Between Rows 6 and 7 is the following Strawberry :

M18 The Duke.

Row 7. Contains specimens of a number of varieties of Apple Stocks growing upon their own roots.

Tree 1	A20 / 1	Free Stock Malling Type XII.
2	A1	Broadleaved English Paradise Malling Type I.
3	A29 / 1	Rivers' Nonsuch Paradise Malling Type VI.
4	A2	Doucin Malling Type II.
5	A13	Doucin " Ameliore " (Improved Doucin) Malling Type V.

Row 7—*continued.*

Tree 6	A5/1	"Hollyleaf" Paradise Malling Type III.
7	A39/1	French Paradise Malling Type VIII.
8	A76/1	Paradise Malling Type XVII.
9	A36	Paradise Malling Type VII.
10	A19/1	Paradise Malling Type XI.
11	A51	Free Stock No. 51 Long Ashton (Bristol).
12	D40	Pyrus Sargentii.

Between Rows 7 and 8 is interplanted the following Strawberry:

M3 Madame Kooi.

In Row 7 between the trees are planted specimens of the following Raspberries:

L12 Heytor (Autumn fruiting).
L13 Alexandra Autumnal.
L14 Yellow Antwerp.
L28 Hailsham Berry.
L27 Everbearing.
L62 Northumberland Fillbasket var.

Row 8. Contains varieties of so-called Mussel Plums, certain Plums growing upon their own roots and other specimen plants.

Tree 1-3	E105	Evesham Wonder Plum.
4	E103	Mussel Plum var. (Catherwood).
5	E79	Shiny Mussel Plum var. (Kew).
6	E106	Mussel Plum var. (Barnham).
7	E61	Rivers' Early Prolific Plum on own roots.
8	A255	Hordle (local "Knot" Apple used as Stock).
9	D36	Pyrus Niedzwetzkana.
10	E56/1	Victoria Plum on own roots.
11	E63	Czar Plum on own roots.
12	G15	Prunus Pissardii.

In Row 8 and between Rows 8 and 9 are planted the following Strawberries :

M1 Jacunda.
M9 Amazone.

Row 9. L29 Loganberry.

Between Rows 9 and 10 is planted the following Strawberry :
M5 Royal Sovereign (Tamar Valley Stock).

Row 10. Contains varieties of Apple used by Dutch Nurserymen as intermediate grafts.

Tree 1-3	A207	Wyker Pippeling.
4-7	A208	Zoete Aagt.
8-11	A208	Zoete Aagt or possibly Dubbel Aagt.
	1	
12	A285	Maidstone Favourite Apple (Bunyard).

In Row 10 and between Rows 10 and 11 is planted the following Strawberry :

M4 Madame Lefebvre.

Row 11. Contains varieties of Plum.

Tree 1	E65	Utility (Laxton).
2	E66	Blackbird (Laxton).
3	E67	Supreme (Laxton).
4	E68	Prosperity (Laxton).
5	E69	Early Laxton.
6-9	E70	Bastard Orleans local var. of Plum grown on own roots in Southampton district.
11		
122	E71	St Julien de Toulouse Plum Stock.

In Row 11 and between Rows 11 and 12 are the following Strawberries :

M6 Royal Sovereign (Tamar Valley Stock).
M7 Royal Sovereign (Norwich Stock).

Row 12. Contains varieties of Plum and Apple.

Tree 1-5	E72	Bastard Victoria, local variety of Plum grown on own roots in Norwich district.
6	E132	Laxton's Gage.
7-10	E73	Westmorland Damson.
11	A202	Bedford Pippin Laxton).
12	A203	Owen Thomas (Laxton).
13	A204	Premier (Laxton).

In Row 12 and between Rows 12 and 13 are the following Strawberries:

M8	Royal Sovereign (Cheddar Stock).
M9	Royal Sovereign (Cheshire (Stock).

Row 13. Contains specimen Plum Stocks, growing on own roots, varieties of Apple and Pear and other specimens.

Tree 1	E10/1	Myrobolan A Selected Plum Stock Type.
2	E10/2	Myrobolan B Selected Plum Stock Type.
3	E10/3	Myrobolan C Selected Plum Stock Type.
4	E10/4	Myrobolan D Selected Plum Stock Type.
5	E37/1	Myrobolan Purple Leaved Variety.
6	E74	Seedling White Damas Plum Stock.
7-8	A206	Gooseberry Pippin Apple.
9	G20	Prunus padus (Hillier).
10	A205	Duchess of Bedford Apple (Laxton).
11	B30	Superb Pear (Laxton).
12	A275	Laxton's Superb Apple.
13	A101	Paradise Præcox var. (Bunyard).

In Row 13 are planted the following Strawberries:

M10	Sir Joseph Paxton (Norwich Stock).
M11	Sir Joseph Paxton (Hampshire Stock).

Between Rows 13 and 14 is Strawberry:

M14	Little Scarlet (Essex Stock).
M11	Sir Joseph Paxton (Hampshire Stock).

Row 14. Contains specimen plants of various root-stocks for Plums and Peaches.

Tree 1	E75	Quetsche Plum var. (Kew).
2	E76	Seedling Plum, Pershore × Kirke's Blue, which shows "root knots" (Laxton).
3	E15/1	St. Julien A Selected Plum Stock Type.
4	E15/2	St. Julien B Selected Plum Stock Type.
5	E15/3	St. Julien C Selected Plum Stock Type.
6	E15/4	St. Julien D Selected Plum Stock Type.
7	E17/1	Black Damas A Selected Plum Stock Type.
8	E17/2	Black Damas B Selected Plum Stock Type.
9	E17/3	Black Damas C Selected Plum Stock Type.
10	E17/4	Black Damas D Selected Plum Stock Type.
11	E78	Quetsche Plum var. (Luxembourg).
12	G6/1	Seedling Common Peach.
13	G6/2	Seedling Common Peach.

In Row 14 is planted the following Strawberry:

M12 Sir Joseph Paxton (Norfolk Stock).

Between Rows 14 and 15 is planted Strawberry:

M13 Stirling Castle (Surrey Stock).

Row 15. Contains varieties of Quince used as root stocks, varieties of Apple and Pear.

Tree 1	C4/1	Quince, Type A1.
2	A140	Clarke's Seedling or Royal George.

Row 15—*continued.*

Tree 3	C10/2	Quince Type 10E.
4	A140	Clarke's Seedling.
5	C5/2	Quince Type 5E.
6	A140	Clarke's Seedling.
7	C10/1	Quince Type D1
8	A134	Ponsford Apple.
9	C4/2	Quince Type 4S.
10	B31	Bartlett Pear (Chivers).
11	A134	Ponsford Apple.
12	B31	Bartlett Pear.
13	A134	Ponsford Apple.

Interplanted in Row 15 are the following Red Currants :

J3	Fertility.
J2	Raby Castle.
J5	Scotch.
J8	Versailles.
J1	Houghton Castle.
J9	Unidentified variety.
J6	Albert.
J4	Victoria.
J22	Laxton's Perfection.

Also Gooseberry :

K15	Triumph.
K16	Sinclair Berry, supposed Gooseberry × Black Currant.

Between Rows 15 and 16 is planted Gooseberry :

K12	Green Ocean.

Row 16. Contains specimens of large fruited and other Quinces and Quince Stock Types grown on own roots.

Tree 1	C18	Meech's Prolific.
2	C17	Bereczki.

Row 16—*continued.*

Tree 3	C16	Champion.
4	C7	Portugal (Type E Stock).
5	C8	Apple Shaped (Type F. Stock).
6	C6	Pear Shaped (Type G Stock).
7	C1	Angers (Type A Stock).
8	C3	Common (Type B Stock).
9	C5/1	De Fontenay (Type D Stock) (France).
10	C2	Supposed Angers var. (Type C Stock).
11	C9	" Kwee " (Type C1 Stock) (Holland).
12	C19	Wilsoni.
13	C24	Vranja.

In Row 16 is planted Gooseberry :

K18 Lancashire Lad.

Between Rows 16 and 17 are planted Gooseberries :

K5 Leveller.
K4 Freedom.

Row 17. Contains specimens of Apple Stocks illustrating range of vigour in so-called Paradise, also some seedling Apples.

Tree 1	A57	Doucin U2 Späth (Berlin) Malling Type XIII.
2	A60/2	Doucin U2 Späth (Berlin) Malling Type XV.
3	A56	Doucin U1 Späth (Berlin) Malling Type X.
4	A58/1	Doucin U3 Späth (Berlin) Malling Type XVI.
5	A60/1	Doucin U3 Späth (Berlin) Malling Type XIV.
6	A2	Doucin Malling Type II.
7	A13	Doucin " Ameliore " Malling Type V.
8	A47	Jaune de Metz Malling Type IX.
9	A11	Dutch or Holstein Doucin Malling Type IV.
10	A228/1	Seedling Siberian Crab.

Row 17—*continued.*

Tree 11	A228/2	Seedling Siberian Crab.
12	A228./3/13	Seedling Siberian Crab.

Between Rows 17 and 18 are planted Gooseberries:

K4	Freedom.
K7	White Lion var. (Barnham),
K3	White Lion var. (Pyne).

Row 18. Contains specimen seedling "True French Crabs," illustrating range of vigour found in so-called "Free" Stocks; also other species of Pyrus, etc.

Tree 1	A77/1	Seedling Crab Type A.
2	A77/3	Seedling Crab Type C.
3	A77/5	Seedling Crab Type F.
4	A77/2	Seedling Crab Type B.
5	A77/6	Seedling Crab Type G.
6	A77/4	Seedling Crab Type E.
7	A77/8	Seedling Crab Type J.
8	A77/7	Seedling Crab Type H.
9	D1	Wild Service var. P. torminalis (Little and Ballantyne).
10	D2	White Beam var. P. aria (Little and Ballantyne).
11	B1/1	Seedling Pear Free Stock.
12	B1/2	Seedling Pear Free Stock.
13	B2/1	Seedling Wild Pear.
14	A40	Northern Spy Apple.

Between Rows 18 and 19 the ground is temporarily occupied with a Root Treatment Experiment in which the tree roots at time of planting have been subjected to different treatments :

(*a*) Carefully lifted and replanted, roots untouched.
(*b*) Replanted after all fibre has been removed.
(*c*) Replanted after all coarse roots have been removed.
(*d*) Replanted after all roots have been cut off.

Rows 19 to 23 inclusive contain a number of varieties of Plum (3 trees of each).

Row 19.

Tree 1-3	E43	Shropshire Prune Damson.
4-6	E44	Black Bullace.
7-9	E45	Cherry Plum (Myrobolan).
10, 11	E46	Kea (local Cornish variety).
12	E77	Cambridge Gage.

Row 20.

Tree 1-3	E47	Greengage.
4-6	E48	Denniston's Superb Gage.
7-8	E49	" French Prune."
10-12	E50	" German Prune."

Between Rows 20 and 21 the ground is temporarily occupied with a Depth Planting Experiment, to test the effect upon the root system. The trees are planted as follows :

(*a*) On the surface.
(*b*) Union just covered.
(*c*) Union 6-in. below ground.
(*d*) Union 1ft. below ground.
(*e*) Union 1ft. 6in. below ground.
(*f*) Union 2ft. below ground.

Row 21.

Tree 1-3	E51	White Magnum Bonum.
4-6	E1	Pershore Egg on own roots.
7-8	E53	Magnum Bonum on own roots.

Row 21—*continued.*

Tree 9, 10	E54	Warwickshire Drooper on own roots (Warwick).
11, 12	E55	Warwickshire Drooper on own roots (Evesham).
13	E64	Blaisden Red, local var., grown on own roots in Gloucestershire.

Between Rows 21 and 22 the ground is temporarily occupied by a row of seedling Apples grown in Cordon form.

The main object is to see whether seedlings can be hastened over their "juvenile period" by the use of either a very dwarfing or very vigorous stock. The seedling Apples used are some from the John Innes Horticultural Institution, Merton.

There are also some Cordon Cox's Orange Pippin here on Paradise Stock Type I. (Broad leaved English Paradise) Type II., (Doucin), Crab H.

Row 22.

Tree 1-3	E56	Victoria.
4-6	E57	Giant Prune (Burbank's).
7-9	E58	Belle de Louvain.
10-12	E59	Pond's Seedling.
13	E64	Blaisden Red.

Between Rows 22 and 23 the ground is temporarily occupied by a row of Cordon Dessert Apples on various stocks: these are being used for observations upon Summer Pruning. The varieties are Cox's Orange Pippin, Allington Pippin and Rival, planted as follows:—

No. 1	Cox's on Type V. (5 trees).
2	Cox's on Bramley's on Type V. (5 trees).
3	Allington on Type II. (5 trees).
4	Cox's on Type III. (5 trees).
5	Rival on Type IX. (5 trees).,
6	Cox's on Type IX. (5 trees).
7	Cox's on Type IV. (5 trees).
8	Allington on Type IV. (5 trees).
9	Cox's on Type II. (10 trees).

These trees are all duplicated in the row, labels numbered as in the above series.

Row 23.

Tree 1-3	E60	Black Diamond.
4-6	E61	Rivers' Early Prolific.
7-9	E67	Monarch.
10-12	E63	Czar.
13	E64	Blaisden Red.

Row 24. Contains specimen trees of various Cherry and Plum Stocks growing on their own roots.

Tree 1	F12	P. cerasus, avium, Seedling Mazzard, Gean or Gaskain Cherry.
2	F3	Cerasus austera Seedling.
3	F16	P. austera Seedling.
4	G26	P. padus, Bird Cherry var. (Little and Ballantyne).
5	F7	P. Mahaleb Seedling.
6-8	E17	Black Damas Seedling.
9-11	E15	St. Julien Seedling.
12	E6	Narrow leaved Mussel.
13		
14	E20	Cluster Damson (Farleigh Damson).

Row 25. Contains specimens of various Plum Stocks growing on their own roots.

Tree 1	E2	Brussel.
2	E19	Kroosjespruim (Dutch).
3	E1	Pershore Egg.
4	E14	P. domestica Seedling (Germany).
5	E18	Varkenspruim (Dutch).
6	E17	Black Damas Seedling.
7	E10	Mryobolan Seedling.
8	E15	St. Julien Seedling.
9	E9	Mariana.
10	E5	Common Mussel.
11	E8	Brompton.
12	E21	Bush Plum var. (Edmonds).
13	E7	Broad-leaved Shining Mussel var. (Jackman).
14	E12	Common Plum.

Rows 26 and 27. Consist of Greengage and Winesour Plums planted alternately, with the object of trying to crop the old Greengage. Incidentally several varieties of "Greengage" have been found amongst these trees, though they all purported to be the Cambridge Gage.

Row 28. Contains trees of Apples, varieties:

A104 Lane's Prince Albert.
A105 Bramley's Seedling.
A106 Allington Pippin.

These are "Pedigree" trees, i.e., the buds were taken from trees of known cropping history. These trees were meant to serve as a nucleus for further buds and grafts.

Plots III. and IV.

These two Plots form the *Apple Pruning Plot.*

Plot III. was planted in the spring of 1915, and Plot IV. in 1914. Trees of fifteen varieties have been treated in four different ways, eight or sixteen trees of each variety being devoted to each treatment. The trees were originally obtained from nurserymen on trade "Paradise" and "Free" stocks. Thus nothing definite was known as to the types of stock on which they were worked, though precautions were taken to obtain trees only of a definite grade. Root cuttings have been taken of each tree, and it is hoped by this means to determine this unknown factor. In every four rows there are two varieties interplanted 14ft. each way on the square. Each row is treated in a different manner. For example:

Row 1 to 4. V=Early Victoria on "Paradise."
B=Bismarck on "Free,"

Row 4.	A "Unpruned"	V.B.V.B.V.B.V.B.V.B.V.B.V.B.
Row 3.	B. "Longspurred"	B.V.B.V.B.V.B.V.B.V.B.V.B.V.
Row 2.	C. "Open-Centre"	V.B.V.B.V.B.V.B.V.B.V.B.V.B.
Row 1.	D. "Shortspurred"	B.V.B.V.B.V.B.V.B.V.B.V.B.V.

E ——— Road ——— W

Methods of Pruning :—

(1)	D. Shortspurred.	Leaders tipped. Laterals cut to *one* good bud.
(2)	C. Open-Centre.	Leaders not tipped. Centre kept open as far as possible and crossing branches removed. Laterals not spurred except for this purpose.
(3)	B. Longspurred.	Leaders tipped. Laterals cut to *three* good buds.
(4)	A. Unpruned	This row is used as a control and since the second year has been allowed to grow naturally, thus illustrating natural habit of growth and fruiting.

N.B. No attempt is made on this Plot to demonstrate the ideal method of pruning for any particular variety. The Plot has been used to study the response of each variety to certain definite treatments. It illustrates this point admirably

Plot III.

The following varieties beginning from the East, form this Plot :—

Rows 1 to 4	Early Victoria on " Paradise."
	Bismarck on " Free."
5 to 8	Norfolk Beauty on " Paradise."
	A. Elizabeth on " Paradise."
9 to 12	Early Victoria on " Free."
	James Grieve on " Paradise."
13 to 16	Gladstone on " Free."
	Cox's Orange Pippin on " Paradise."
17 to 20	James Grieve on " Free."
	Rival on " Paradise."
21 to 24	Lord Derby on " Paradise."
	Gladstone on " Paradise."

(The Annie Elizabeths were planted in the autumn of 1916, replacing King Edward VII.)

Plot IV.

Rows 25 to 28	Grenadier on "Free." Worcester Pearmain on "Paradise."
29 to 32	Worcester Pearmain on "Free." Allington Pippin on "Paradise."
33 to 36	Beauty of Bath on "Paradise." Grenadier on "Paradise."
37 to 40	Newton Wonder on "Paradise." Lane's Prince Albert on "Free."

N.B.—For Published Results of Pruning Experiments see :

Annual Report, East Malling Research Station, 1914 to 1922.
Winter Pruning Experiments with Apple Trees. N. H. Grubb, M.S.A., 1922.
Notes on Pruning. N. H. Grubb, M.S.A., 1923.

Plot V.

One row of fruiting Cherry stocks, illustrating seedling variations. Beginning at the North End.

Tree 1	$\frac{F1}{2}$	1B Common Cherry.
2	$\frac{F1}{3}$	1C Common Cherry.
4	$\frac{F1}{6}$	1F Common Cherry.
5	$\frac{F2}{4}$	2D Black Mazzard.
6	$\frac{F3}{2}$	3B Cerasus austera.
7	$\frac{F3}{4}$	3D Cerasus austera.
8	$\frac{F3}{6}$	3F Cerasus austera.
9	$\frac{F6}{1}$	6A Mahaleb Cherry.

Tree 10	F6/2	6B Mahaleb Cherry.
11	F8/1	8A Mahaleb Cherry.
12	F8/2	8B Mahaleb Cherry.
13	F10/1	10A Common Cherry.
14	F10/2	10B Common Cherry.

Black Currants. Permanent Collection Bed.

This collection is still in the process of formation. It consists of a number of lesser known and new-named sorts. The rows run from East to West and are labelled.
The first series of varieties is seven bushes wide, and is planted as follows :—

H73	Bang Up.	3 rows deep, planted winter 1921-22.
H74	Long Bunch.	3 rows deep, planted winter 1921-22.
H75	Coronation,	3 rows deep, planted winter 1921-22.
H76	Tinker,	3 rows deep, planted winter 1921-22 (Laxton).
H78	Cherry Black,	3 rows deep, planted winter 1921-22.
H77	F. Seedling,	3 rows deep, planted winter 1921-22 (Laxton).
H79	Eagle,	3 rows deep, planted winter 1921-22 (Saunders, Canada).
H80	Kerry,	3 rows deep, planted winter 1921-22 (Saunders, Canada).
H81	Topsy,	3 rows deep, planted winter 1921-22 (Saunders, Canada).
H82	Climax,	3 rows deep, planted winter 1921-22 (Saunders, Canada).
H83	Ontario,	3 rows deep, planted winter 1921-22 (Saunders), Canada).
H84	Buddenberg,	3 rows deep, planted winter 1921-22 (Saunders, Canada).
H71	Daniel's September,	2 rows deep, planted winter 1921-22.
H86	Kippen Seedling,	2 rows deep, planted winter 1921-22 (Marshalls').

The second series consists of two rows each, two bushes wide of specimen bushes of varieties received from different districts.

H159 Baldwin (Norfolk).
H160 French (Norfolk).
H161 Unnamed (Norfolk).

The third series of varieties is seven bushes wide and is planted as follows:

H143	Theunis,	3 rows deep.
H142	Defender,	3 rows deep.
H140	Long Bunch,	3 rows deep.
H150	Prolific,	3 rows deep (Owen English).
H153	Ensden Defiance,	3 rows deep (I. Neame).
H154	Carter's Champion,	3 rows deep.
H171	Baldwin,	3 rows deep.
H145	French,	3 rows deep (Benton's).
H136	Victoria,	3 rows deep.
H139		
H134	Black Prince,	3 rows deep.
H149	Orr's Seedling,	3 rows deep.
H118	Hatton Black,	3 rows deep (Jones).
H119	Hatton Giant	3 rows deep (Jones).
H120	Peplow Black,	3 rows deep (Jones).

The fourth series of varieties in this Plot is six bushes wide and is planted as follows:—

H133 Nicholl's Seedling, 3 rows.

Plots VI. and VII.

Plots VI. and VII. were formerly occupied by Apple Stock Beds and Black Currant Manurial Trials, respectively. These Plots are now temporarily being planted with annual crops.

Plot VIII.

Great East Hop Garden.

(A separate yearly guide to the Hop Garden is issued.)

Plot IX.

Hospital.

Certain diseases of Root Stocks, etc., are kept here under observation.

Plots X. to XIV.

Apple Stock Trials (*see plan*).

1. General Explanation.

These trials are for the purpose of testing thoroughly the various types of Apple Stocks classified at East Malling. Records have been kept which tend to show that root stock influences :—

(*a*) Vigour of the tree.
(*b*) The age at which the tree begins to bear.
(*c*) The root-hold of the tree.
(*d*) The characters of the fruit.
(*e*) And possibly, liability to certain diseases and pests.

Three varieties have been selected to represent :—

(1) Weak growing.
(2) Medium.
(3) Strong growing varieties.

These are :

(1) Lane's Prince Albert. Plots X. and XI.
(2) Worcester Pearmain. Plots XII., XIII. and XIV.
(3) Bramley's Seedling. Plots X., XII., XIII., and XIV.

In Plot XI. Grenadiers to be trained as standards were planted in the winter of 1922-23. They are worked on strong stocks.

The following stocks are represented in these trials :

" Paradise " Types I. to XVI. inclusive.
" Free " and " Crab " Types A.C.E.H.F.51 (Bristol No. 5), and Northern Spy.

The trees are, as far as possible, distributed over the ground in small groups so as to check soil differences. In most cases the unit of trees for experimental purposes is thirty-two of each variety on each stock distributed in blocks of four.

Plot X. was planted in April, 1919, as Maiden trees.

Plots XI. to XIV. were planted in January, 1920, as Maiden trees.

All these Plots are labelled from Right to Left. (West to East) with the exception of:

(1) Bramleys on Plot X.
(2) Grenadiers on Plot XI.

which are labelled North and South.

For published results of Apple Stock Trials, etc., see: *Annual Report*, East Malling Research Station, 1922, page 20, "The Importance of Suitable Stocks in Planting Young Fruit Trees." R. G. Hatton, 1921.

Inter-cropping. The stock trials are intercropped throughout with soft fruits.

Plot X.

Plot X. This consists of Bush Lane's Prince Albert and half-standard Bramley's Seedling, worked on known stocks.

This is the oldest Plot in the stock trials, and here the effects of stock on the tree are well illustrated.

Note specially the Lane's Prince Albert on Types I., II., IX. and XVI.

The South half of the Plot is unpruned.

See detailed plan, page 70.

This Plot is intercropped both between and in the rows with Black Currants, showing the four main types:—

(1) Goliath.
(2) Boskoop.
(3) Baldwin.
(4) French.

and named sorts which are grouped with these varieties. Odd numbered rows are full rows of currants, even numbered rows interplanted in the tree rows.

Row 1	H73	Bang Up (Goliath type).
Row 2	H41	Monarch (Goliath type).
	H53	Edina (Goliath type).
Row 3	H7	Goliath.
Row 4	H38	Carter's Champion.
	H133	Nicholl's Black (Baldwin type).
	H62	Buddenburg's Black Prince (Baldwin type).

Row 5	H19	Boskoop Giant.
Row 6	H60	Prince of Wales (Boskoop type).
	H8	Hoogendyk's Seedling (Boskoop type).
Row 7	H28	Baldwin.
Row 8	H37	Black Naples* (French type).
	H5	Lee's Prolific* (French type).
Row 9	H1	Merveille de la Gironde (French type).
Row 10	H4	North Holland Black (French type).
	H66	Black Grape (French type).
	H2	Ogden's Black (French type).
Row 11	H3	Seabrook's Black (French type).
Row 12	H67	Resister (French type).
	H63	Siberian (French type).
Row 13	H55	Blacksmith.
	H64	Edmond's Seedling (Boskoop type).
Row 14	H56	Mammoth (French type).
	H65	Westwick (French type).

* These names are frequently used for more than one variety, but were retained here for varieties showing certain points of distinction.

N.B.—"Black Currant Varieties—A Method of Classification." R. G. Hatton. 1920.

Plot XI.

This is a repetition of Plot X., planted a year later. Lane's Prince Albert (bush trees) on a wide range of stocks are here on trial. Half-standard Grenadiers were also planted in January, 1923, as two-year feathered trees; these are worked on various free-growing stocks. (See Plan on page 71–72.)

This plot is also intercropped with Black Currants in and between the rows.

Rows 1 to 16 are used for experiment in relation to the control of "Big Bud." One full row (73 bushes) and one interplanted row (24 bushes) form each plot.

Rows 1, 2, 15, 16. All big buds hand picked.

Rows 3, 4, 13, 14. Sprayed Lime Sulphur in the spring.

Rows 5, 6, 11, 12. Even numbered bushes cut to ground one year, odd numbered bushes the next year.

Rows 7, 8, 9, 10. Control, untreated.

H92 Baldwin is the variety used.

The rest of the Plot is devoted to testing Baldwins from different sources.

Row 17 and 18	H28	Baldwin (late R. Mercer).
Row 19 and 20	H51	Baldwin (synonym) Lee's Prolific (Col. Honeyball).
Row 21 and 22	H52	Baldwin (synonym) Lee's Prolific (S.E.A.C.).
Row 23 and 24	H40	Baldwin (synonym) Carter's Champion (I. Neame).
Row 25 and 26	H87	Baldwin (S. Lee).
Row 27 and 28	H88	Baldwin (G. Pyne).
Row 29 and 30	H89	Baldwin (King's Acre).
Row 31 and 32	H92	Baldwin (W. Tolhurst).
	H91	Baldwin (Wakeley Bros.).

Plots XII., XIII., XIV.

Apples.

These Plots consist of Bush Bramley's Seedling and Worcester Pearmain Apples on a wide range of stocks (see Plans, on pages 73–75).

They (and also Plots XV. and XVI.) are intercropped with Raspberries between, and Black Currants in, the rows.

Plots XII. to XVI. inclusive have Black Currants planted in the tree rows, as follows :—

Plots XII. and XIII.

H92 Baldwin.

Plot XIV.

Rows 1-5	H48	Seabrooks.
Row 6	H66	Black Grape.
Row 7.	H63	Siberian.
Row 8	H2	Ogden's Black.
Row 9	H4	North Holland Black.
Row 10	H67	Resister.

PLOT XV.

Row 1 H71 September Black.
Row 2 H67 Resister.
Rows 3 and 4 on Plot XV. and Rows 1 to 10 on Plot XVI. are interplanted with new seedlings of controlled Parentage, under trial.
Row 3 H98/7 N. Def. 2 (31).
Row 4 H98/6 N. Def. 2 (17).

PLOT XVI.

Row 1 H98/5 N. Def. 2 (5).
Row 2 H102/1 Th. Cor. 2 (17).
Row 3 H103/1 Th. Cor. 6 (26).
Row 4 H101/1 Th. Vic. 5 (5).
Row 5 H96/7 N. Bos. 4 (32).
Row 6 H97/9 N. Bos. 5 (93).
Row 7 H97/8 N. Bos. 5 (81).
Row 8 H97/7 N. Bos. 5 (56).
Row 9 H97/6 N. Bos. 5 (55).
Row 10 H97/5 N. Bos. 5 (12).

The full rows of true varieties of Raspberries (Plots XII., XIII., XIV.) are intended for cropping trials and propagation purposes; Plots XII. and XIII. are manured, while plot XIV. receives no manure; thus these also form a Manurial trial.

Those on Plots XV. and XVI. are a wide collection of named sorts, planted out as they come in for roguing and labelled with the names under which they were received.

They will eventually be included in the Cropping trials.

The Raspberries on Plots XII., XIII., XIV. are labelled under the names as present recommended for use, as follows :—

PLOT XII.

Row 1.		
	L3	Baumforth's B.
Row 2.		
	L5	Superlative.
Row 3.		
	L1	Bath's. Perfection.
Row 4.		
	L10	Norwich Wonder.
Row 5.		
	L7	Devon.
Row 6.		
	L8	Royal.
Row 7.		
Row 8.		
	L2	Hornet C.
Row 9.		
Row 10.		
	L6	Profusion.

PLOT XIII.

Row 1.		
	L18	Abundance.
Row 2.		
	L15.	Black Antwerp A.
Row 3.		
	L26	Reader's Perfection.
Row 4.		
	L25	Red Cross.
	L45	Laxton's Bountiful.
	L19	Laxton's Bountiful.
Row 5.		
	L38	Semper Fidelis.
	L35	Mitchell's Seedling.
Row 6.		
	L24	Red Antwerp B.

Row 7.
L3 Baumforth's B.
Row 8.
L7 Devon.
Row 9.
L8 Royal.
Row 10.
L7 Devon.

PLOT XIV.

Row 1.
L3 Baumforth's B.
Row 2.
L2 Hornet C.
Row 3.
L1 Bath's Perfection.
Row 4.
L8 Royal.
Row 5.
L7 Devon.
Row 6.
L3 Baumforth's B.
Row 7.
L2 Hornet C.
Row 8.
L1 Bath's Perfection.
Row 9.
L3 Baumforth's B.
Row 10.
L7 Devon.

PLOT XV.

Row 1.
L48 Hornet A.
L49 Hornet A ("Improved Hornet").
Row 2.
L23 Hornet A.
L44 Hornet A.
L51 "Red Antwerp."
L55 Lloyd George.

Row 3.

L41	Black Antwerp A.
LB6	Black Antwerp A.
L37	Red Antwerp A.
L15/1	Red Antwerp A.
L15/2	Victoria (?).

Row 4.

L54	"Red Antwerp" (mixed).
L54/2	(Selections from L54).
L54/3	(Selections from L54).
L54/4	(Selections from L54).
L50	Black Antwerp B. (Barnet ?).
L53	Penwill's Champion.
L23/3	(Rogues from Hornet A).
L48/1	(Rogues from Hornet A).

Plot XVI.

Row 1.

L39	Steele's Victoria.
L54/1	(Selections from L54).
L54/5	(Selections from L54).
L54/3	(Rogue from Hornet A).
L42/4	"Laxton" (Norwich Wonder ?).
L52	Norwich Market.
L23/1	(Rogue from Hornet A).

Row 2.

L34 Baumforth's B.
L43 Baumforth's B.
L32 Baumforth's A.
L30 Skinner's Seedling.
L79/1 (Rogue).
L45/1 (Rogue).
L22/1 Helston.
L20 Helston.

Row 3.

L47 Kirriemuir Fillbasket.
L47/1 (Rogue).
L21/1 (Rogue).
L46 Inkpen Wonder.
L94/2 (Rogue).
L33 Prior's Prolific.
L31 Paradise Berry.
L32/1 (Rogue).
L83/1 (Rogue).

Row 4.

L21 Improved Beehive.
L10/1 (Rogue from Norwich Wonder).
L2/1 (Hornet A. rogue from Hornet C).
L6/1 (Red Antwerp C (?) rogue from Profusion).
L6/2 (Bath's Perfection, rogue from Profusion).
L6/3 (Nameless rogue from Profusion).

L6 (Red Magnum Bonum, rogue from Profusion).
4
L3 (Baumforth's A, rogue from Baumforth's B).
1
L3 (Nameless rogue from Baumforth's B).
2
L11 (Rogue).
1
L12 (Rogue).
1
L32 (Rogue).
2

Row 5.

L49 (Hornet C. rogue from Hornet A).
1
L50 (Rogue).
2
L50 (Rogue).
3
L23 (Rogue).
2
L44 (Rogue).
1
L34 (Rogue).
1
L43 (Rogue).
1
L40 (Rogue).
1
L86 Fillbasket A.
L92 (Rogue).
1
L53 (Rogue).
1
L4 (Two forms received as "Hornet").
1
L4 (Two forms received as "Hornet").
2
L57 Fillbasket B.
L10 Norwich Wonder.

Row 6.

L87 Red Antwerp E.
L65 Red Antwerp F.
L11 Park Lane.
L59 Canadian Red.
L62 Northumberland Fillbasket (Baumforth's B).
L138 Wisbech Wonder.
L67 Northumberland Fillbasket Thornless.
L22 North Ward.
L58 Woolfe's Seedling.
L84 Storrie's Invincible.

Row 7.

L63 Lynn's Seedling.
L85 Storrie's Invincible.
L64 Daleek Seedling.
L64/1 (Rogue from Daleek Seedling).
L64/2 (Rogue from Daleek Seedling).
L94/1 (Rogue from Sclater's Seedling).
L94/3 (Rogue from Sclater's Seedling).
L69 Laxton's Prolific.
L80/1 (Rogue).
L83 Filby Seedling.
L88 Chummies.

Row 8.

L70 Unnamed seedling sent for trial.
L71 Unnamed seedling sent for trial.
L72 Unnamed seedling sent for trial.
L73 Unnamed seedling sent for trial.
L74 Unnamed seedling sent for trial.
L75 Unnamed seedling sent for trial.
L76 Unnamed seedling sent for trial.
L77 Unnamed seedling sent for trial.
L78 Unnamed seedling sent for trial.

Row 8—*continued*.

L79 Unnamed seedling sent for trial.
L80 Unnamed seedling sent for trial.
L81 Unnamed seedling sent for trial.

Row 9.

L89 Fastolf.
L90 " Carter's Prolific " (?).
L91 " Carter's Prolific " (Baumforth's A).
L92 " Carter's Prolific " (Red Antwerp B).
L93 Wickham Thimble.
L94 Sclater's Seedling.
L95 Seldon Seedling.
L98 Engelsche Roode (Superlative).

Row 10.

L96 Winkler's Seedling.
L97 Winkler's Seedling.
L99 Wilder.
L100 Roosjes.
L101 Souvenir de Bruneau.
L102 Verbeterde (Improved) Hornet.
L103 Haagsche Bruine.
L104 Oude Zundersche.
$L\frac{54}{4}$ (Selections from L54).
$L\frac{45}{8}$ (Selection from L54).
$L\frac{54}{6}$ (Selection from L54).
$L\frac{54}{7}$ (Selection from L54).
$L\frac{54}{9}$ (Selection from L54).
$L\frac{54}{10}$ (Selection from L54).
$L\frac{51}{1}$ (Rogue from Red Antwerp).
$L\frac{51}{2}$ (Rogue from Red Antwerp).

Row 10—*continued.*

$\frac{L72}{1}$ (Rogue).

$\frac{L74}{1}$ (Rogue).

* See "Commercial Raspberries and Their Classification." N. H. Grubb, 1922.

Plot XV.

Pear and Plum Stock Trials. Planted Spring, 1920.

This Plot consists of :—

(1) Plums E56. Victoria on the following Stocks :—

Pershore.
Brussels.
Common Mussel.
Common Plum.
Brompton.
Myrobolan (Seedlings).
St. Julien (Seedlings).

See "Stocks for Stone Fruits." R. G. Hatton, M.A., 1921.

(2) Pears. B15. Fertility on the following Stocks :—

Angers Quince.
Portugal Quince.
Common Pear (Seedling).
Wild Pear (Seedling).
Hawthorn (Seedling).
Mountain Ash (Seedling).
Wild Service (Seedling).
White Beam (Seedling).

The Rows 1 to 4, from Right to Left are :—

(1) Bush Victoria.
(2) Bush Victoria and half-standard Fertility.
(3) Bush Fertility.
(4) Half-standard and bush Fertility.

(See Plan, page 76.)

Plot XVI.

Double Working Plot. (See Plan, on pages 77–78.)

The object here is to test the influence of various intermediates on the characteristics of the variety forming the head, such as vigour, fruitfulness, time of blossoming, time of ripening, colour of fruit, etc.

The rows from Right to Left are lettered a, b, c, d, e, f, g, h, j, k. All intermediates were worked on a single variety of Stock. (Type III.)

Rows a, b, c, d, contain trees of three varieties, Lane's Prince Albert, Worcester Pearmain and Bramley's Seedling, each single worked and double-worked over itself and over each of the others. They are indicated as follows on the Plan :—

Lane's top-worked on Bramley	(L) (B)
Lane's top-worked on Worcester	(L) (W)
Lane's top-worked on Lane's	(L) (L)
Lane's Control (direct on III)	(L) (con.)
Worcester top-worked on Bramley	(W) (B)
Worcester top-worked on Lane's	(W) (L)
Worcester top-worked on Worcester	(W) (W)
Worcester (direct on III.)	(W) (con.)
Bramley top-worked on Worcester	(B) (W)
Bramley top-worked on Lane's	(B) (L)
Bramley top-worked on Bramley	(B) (B)
Bramley (direct on III.)	(B) (con.)

Rows a and c. All trees in these rows have 2ft. length of intermediate.

Nearly all trees in Rows b and d have 3-ins. length of intermediate.

Row e contains trees of Cox's Orange Pippin indicated on the Plan as follows :—

Cox top-worked on Stirling	(C)/(S)
Cox top-worked on Bramley	(C)/(B)
Cox top-worked on Bismarck	(C)/(Bis.)
Cox (direct on III.)	(C)/(con.)

Row f contains trees of Duchess Favourite and Blenheim Orange alternately, indicated on the Plan as follows :—

Duchess Favourite top-worked on W. Wilks	(DF)/(Wi.)
Duchess Favourite top-worked on Quarrenden	(D.F)/(Q)
Duchess Favourite (direct on III.)	(DF)/(con.)
Blenheim top-worked on Stirling	(Bl.)/(S)
Blenheim (direct on III.)	(Bl.)/(con.)

Row g contains trees of Cox's Orange Pippin, indicated on the Plan as follows :—

Cox top-worked on Cox	(C)/(C)
Cox top-worked on Blenheim	(C)/(Bl.)
Cox top-worked on Christmas Pearmain	(C)/(XP)
Cox top-worked on Brownlee's Russet	(C)/(Br.R)
*Cox top-worked on Derby	(C)/(D)
*Cox top-worked on Worcester	(C)/(W)

Row h contains trees of Lane's Prince Albert, Bramley's Seedling and Red Astrachan, indicated on the Plan as follows :—

*Lane's top-worked on Lane's	(L) / (L)
*Lane's top-worked on Worcester	(L) / (W)
*Lane's top-worked on Newton	(L) / (N)
Bramley top-worked on White Transparent	(B) / (WT)
Bramley top-worked on Annie Elizabeth	(B) / (AE)
Bramley (direct on III.)	(B) / (con.)
Red Astrachan top-worked on Jubilee	(Ast.) / (J)
Red Astrachan (direct on III.)	(Ast.) / (con.)

Row j contains trees of Cox's Orange Pippin, indicated on the Plan as follows :—

Cox top-worked on Allington	(C) / (Al.)
Cox top-worked on Early Victoria	(C) / (E.Vic.)
Cox top-worked on Sturmer P.	(C) / (Stu.)
Cox top-worked on Gladstone	(C) / (Gl.)
Cox top-worked on Bramley	(C) / (B)
Cox top-worked on Cox	(C) / (C)

Row k contains trees of Baumann's Red Reinette, Bramley's Seedling, Lane's Prince Albert and Red Astrachan, indicated on the Plan as follows :—

Baumann's top-worked on III. direct	(Bau.) / (con.)
Baumann's top-worked on Grosvenor	(Bau.) / (Gros.)

Baumann's top-worked on Old Nonpariel $\frac{\text{(Bau.)}}{\text{(ON)}}$

Bramley top-worked on III. direct.
Bramley top-worked on Annie Elizabeth.
Bramley top-worked on Winter Transparent.
Lane's top-worked on Worcester.
Lane's top-worked on Lane's.
Red Astrachan top-worked on Jubilee.
Red Astrachan top-worked on III. direct.

* Double worked in one year by using " budded grafts," i.e., bud inserted in shoot of intermediate variety in July ; shoot removed and used as graft in March.

PLOT XVII.

Permanent Pear Stools, etc. (Right to Left.) This Plot shows various selected types of so-called Free Pear Stocks being raised by vegetative methods, so that varieties with desirable characteristics can be multipled readily.

Row 1.

$\frac{B2}{7}$ Seedling Pear.

$\frac{D4}{1}$ White Thorn (layered).

$\frac{D4}{2}$ White Thorn (layered).

$\frac{D4}{3}$ White Thorn (layered).

Row 2. Seedling Wild Pears.

$\frac{B2}{3}$
$\frac{B2}{4}$
$\frac{B2}{3}$
$\frac{B2}{5}$
$\frac{B2}{6}$

Row 2—*continued*.

$\frac{B2}{7}$

$\frac{B2}{8}$

B11 P. Cordata.

B12 Wild Pear var. (Kew).

Row 3. Seedling Free Pears.

$\frac{B\ 1}{12}$

$\frac{B\ 1}{16}$

$\frac{B\ 1}{13}$

$\frac{B\ 1}{17}$

Seedling Wild Pears.

$\frac{B2}{1}$

$\frac{B2}{2}$

Row 4. Seedling Free Pears.

$\frac{B\ 1}{12}$

$\frac{B\ 1}{13}$

$\frac{B\ 1}{14}$

$\frac{B\ 1}{15}$

Row 5. Seedling Free Pears.

$\frac{B1}{6}$

$\frac{B1}{8}$

$\frac{B1}{9}$

$\frac{B1}{10}$

Row 6. Seedling Free Pears.

B 1/10
B 1/1
B 1/10
B 1/4
B 1/5

Row 7. Seedling Pear Stocks.

B3/1
B3/5
B3/6
B3/7
B3/13
B3/16
B4/3
B5/120
B4/1

Selected Pear Suckers.

B13
B14

The remainder of this Plot is devoted to temporary Nursery work, and various trees for experimental purposes are here being raised.

Plot XVIII.

Permanent Stool Beds, etc.

All the following are layered for vegetative propagation : Rows from Right to Left.

Row 1. Apple Stocks.

A57 Type XIII.
A58 Type XVI.
1

At the top of this Row on the right hand is a short row :

Row 1*a*. Pyrus Species.

D7 Pyrus serrulata.
D6 P. calleriana.
D8 P. serotina.
D5 Amelanchier botryapium.

Row 2. Apple Stocks.

A57 Type XIII.

Row 3. Plum Stocks.

E116 St. Julien de Toulouse.
E73 Westmorland Damson.
E14 Prunus domestica.
E142 Selected Suckers of Mussel from Prune Damson Tree.

Row 4.

E116 St. Julien de Toulouse (St. Julien G.) and the following Dutch Plum Stocks :

E112 Roode Kroosjespruim.
E113 Blaume Kroosjespruim.
E114 Octoberblaume.
E115 Enkilde Boer Reinnette.
E130 St. Julien de Toulouse.
E117 White Plum.
1
E117 White Plum.
2

Row 4—*continued.*

E117/3 White Plum.
E117/4 White Plum.
E118/1 Kroosjespruim Seedlings.
E118/2 Kroosjespruim Seedlings.
E118/3 Kroosjespruim Seedlings.

Row 5.

E72 Bastard Victoria.
E55 Warwickshire Drooper.
E53 Magnum Bonum.
E64 Blaisden Red.
E77 Cambridgeshire Gage.
E54 Warwick Drooper.

Selected Wild Hedge Plums :

E124 Long-leaved Type.
E125 Broad-leaved Type.
E6/3 Narrow-leaved Mussel.

Row 6.

E15/6 St. Julien de Toulouse (St. Julien F. No. 14).
E79 Shiny Mussel.
E106 Mussel.
E78 Quetsche.
E133 Harnets Bush.
E139 Blue Kroos.
E63 Czar.
E56 Victoria.
E102 Purple Egg.
E63 Czar.

Row 7.

E76 Pershore × Kirke's.
E108 Margot.
E105 Evesham Wonder.

Row 7—*continued.*

E75 Quetsche.
E6/2 Bastard Common Mussel.
E6/3 Common Mussel Selection.
E83 Kent Bush.
E141 Sandwich Bush.
E119/1 Kroosjespruim Seedling (selected).
E119/2 Kroosjespruim Seedling (selected).
E119/3 Kroosjespruim Seedling (selected).
E119/4 Kroosjespruim Seedling (selected).
E119/5 Kroosjespruim Seedling (selected).
E119/6 Kroosjespruim Seedling (selected).

Row 8.

E7/1 Broad-leaved Mussel (Clone).
E70 Bastard Orleans.
E46 Kea.
E107 Morocco.
E110 Rivers Early Prolific.
E35/1 St. Julien de Toulouse (St. Julien E).

Row 9.

E17/1 Black Damas A.
E17/2 Black Damas B.
E17/3 Black Damas C.
E17/4 Black Damas D.

Row 10.

E10/1 St. Julien Selection (St. Julien A).
E15/2 St. Julien Selection (St. Julien B).
E15/3 St. Julien Selection (St. Julien C).
E35/2 St. Julien Selection (St. Julien J). (Selected sucker).
E15/7 St. Julien Selection (St. Julien H).
E15/4 St. Julien Selection (St. Julien D).

Row 11.

E9 Mariana.
E19 Kroosjespruim.
E20 Cluster Damson.

Row 12.

E10/3 Myrobolan C.
E10/4 Myrobolan D.
E116/1 Myrobolan E.

Row 13.

E10 Myrobolan A.
E10/2 Myrobolan B.

Row 14.

E12 Common Plum.

Row 15.

E5 Common Mussel.

Row 16.

E7 Broad-leaved Mussel.

Row 17.

E8 Brompton.

Row 18.

E2 Brussels.

Row 19.

E1 Pershore.

Row 20. Apple Stocks.

A77/5 Crab F.

A77/7 Crab H.

Plum Stock.

G16 Prunus Podgoritza.

Cherry Stocks.

F16

F3/3

F3/5

F10/2

F10/1

Row 21. Apple Stocks.

A77/1 Crab A.

A77/3 Crab C.

Row 22.

A58/1 Type XVI.

Row 23.

A60/2 Type XV.

Row 24.

A57 Type XIII.

Row 25.

A20/1 Type XII.

Row 26.

A47 Type IX.

Row 27. Mahaleb Seedling Cherries, raised from fruiting trees.

F8/1 Female Parent of group of seedlings.
F8/2 Female Parent of group of seedlings.
F6/1 Female Parent of group of seedlings.
F6/2 Female Parent of group of seedlings.

Row 28. Apple Stocks.

A29 Type VI.

Row 29.

A29 Type VI.

Row 30.

A13 Type V.

Row 31. Seedling Cherries.

F18
F1/1
F10/2
F1/7

Row 31. Apple Stocks.

A245 Selected Wild Apple (Bluebell Hill).
A88/1 Selected Seedling (Grubb).
A82/2 Selected Seedling (Grubb).

Row 32.

A11 Type IV.

Row 33.

A2 Type II.

Row 34.

A2 Type II.

Row 35.

A1 Type I.

Row 36.

A1 Type I.

Row 37. Layered Free Stock.

A51 Long Ashton No. 5 (Malling Collection No. 51).
A52 Long Ashton No. 7 (Malling Collection No. 52).
A50 Long Ashton No. 4 (Malling Collection No. 50).
A49 Long Ashton No. 3 (Malling Collection No. 49).
A48 Long Ashton No. 2 (Malling Collection No. 48).
A60 Type XIV.
1
A19 Type XI.
1

Row 37. Free Stock Seedlings (Malling Selection).

A78 M
3
A78 L
7
A78 K
6
A76 Type 17.
1
A79 (Pierce's Selected).

Row 38.

A58 Type XVI.
1

Row 39.

A20 Type XII.
1
A57 Type XIII.

Row 40.

A56 Type X.
A20 Type XII.
1

Row 41.

A47 Type IX.
A101 Paradise Præcox.

Row 42.

A39 Type VIII.
1

Row 43. Seedling Cherries.

$F\frac{1}{5}$ Female Parent of group of seedlings.

$F\frac{1}{1}$ Female Parent of group of seedlings.

Row 44. Cherry Stocks.

$F\frac{9}{1}$

$F\frac{12}{2}$

$F\frac{12}{3}$

$F\frac{12}{4}$

$F\frac{12}{5}$

F13

F14

FX

$F\frac{1}{5}$

$F\frac{3}{4}$

$F\frac{1}{4}$

$F\frac{3}{6}$

$F\frac{1}{3}$

$F\frac{2}{3}$

Row 45. Cherry Stocks.

$F\frac{5}{5}$

$F\frac{2}{1}$

$F\frac{2}{2}$

Row 45—*continued.*

$\frac{F7}{2}$

G21 P. padus (Hillier).

$\frac{F1}{4}$

Row 46.

$\frac{F5}{1}$

$\frac{F5}{2}$

$\frac{F5}{3}$

$\frac{F5}{4}$

$\frac{F1}{1}$

$\frac{F1}{2}$

Row 47.

$\frac{F12}{1}$

$\frac{F3}{2}$

$\frac{F10}{1}$

$\frac{F10}{2}$

F43

$\frac{F1}{6}$

$\frac{F2}{3}$

Row 48. Apple Stocks.

$\frac{A20}{1}$ Type XII.

Row 49.

A2 Type II.

Row 50.

A2 Type II.

Row 51.

A1 Type I.

Row 52.

A1 Type I.

Row 53. Quince Stock.

C6 Quince G.

Row 53. Apple Stocks.

A251 Duchess of Oldenburg.
A250 Emperor Alexander.
A252 Ben Davis.
A253 Transparent de Croncels.
A40 Northern Spy.
A165 Winter Majetin (Bunyard).
A166 Winter Majetin (Wisley).
A280 Reinnette-Zuccamaglio.
A250 Emperor Alexander.

Row 53. Pyrus species.

D2 White Beam.
D1 Wild Service.

Row 54. Quince Stocks.

C8 Quince F.
C9 Quince C1.
1
C19 Wilsoni
C17 Berezki.
C16 Champion.
C18 Meech's Prolific.

Row 55. Quince Stock.

C7 Quince E.
CF Quince E.

Row 55. Pyrus Species.

D23 Pyrus communis.
D25 Pyrus nivalis.
D26 Pyrus paishia.

Row 55—*continued*.

D30 Pyrus michauxii.
D29 Pyrus sinensis.
D27 Pyrus elaeagrifolia.
D31 Pyrus jaspida.
D32 Pyrus sinaica (possibly).
D24 Pyrus communis.
D33 Pyrus nivalis (possibly).
D28 Pyrus sinaica (possibly).
D16 Pyrus elaeagrifolia.
D17 Pyrus michauxii.
D19 Pyrus pollveria.
D20 Pyrus salicifolia.
D21 Pyrus sinaica
D40 Pyrus baccata.
D42 Pyrus coronaria.
D43 Pyrus dioica.
F44 Pyrus cerasifera.
D45 Pyrus ringo.
D46 Pyrus reversii.
D47 Pyrus prunifolia-dulcis.
D48 Pyrus floribunda var. (purpurea).

Row 55. Prunus Species.

G18 Prunus pumila.

Row 55. Pyrus species.

D37 1 Pyrus prunifolia.
D37 2 Pyrus prunifolia.
D38 1 Pyrus malus toringo.
D38 4 Pyrus malus toringo.
D38 5 Pyrus malus toringo.
D36 Pyrus neidwetzkyana.

Row 55. Apple Stock.

A274 Wild Crab.

Row 56.

C5/2 Quince D1.

Row 56. Apple Stocks. A collection of Commercial varieties, to test self-rooting capability.

A199 Beauty of Bath.
A190 Rival.
A167 Tylers' Kernel.
A183 Early Victoria.
A188 Cox's Orange Pippin.
A243 Blenheim Orange Pippin.
A200 Lane's Prince Albert.
A194 Worcester Pearmain.
A196 Allington Pippin.
A105 Bramley Seedling.
A195 Grenadier.
A193 Lord Derby.
A184 Annie Elizabeth.
A201 Newton Wonder.
A218 Irish Peach.
A215 Potts' Seedling.

Row 56. Pyrus Species.

D6/3 Pyrus calleriana.
D6/4 Pyrus calleriana.
D7/2 Pyrus serrulata.
D8/3 Pyrus serotina.

Row 57. Quince Stock.

C5/1 Quince D.
B109 Pear seedling Peiter van Huig.
B89 Pear sucker. (Teignmouth).
B112 Pear Zoutewel.

Seedling layered Apples, Doucin × Northern Spy (John Innes):

A765

Row 57—*continued.*

A770
A786
A792
A778
A759
A782
A783
A787
A772
A776
A790
A764
A766
A773
A780
A762
A774
A760

Varieties of Apple to test self-rooting capabilities.

A255 Hordle.
A95 Genet Moyle.
A98 Stubbard.
A93 Oslin.
A92 Lord Suffield.
A96 Manx Codlin.
A164 Carlisle Codlin.

Row 58. Quince Stock.

C2 Quince C.

Row 58. Pyrus Species.

D39 Pyrus Malus.
D7/2 Pyrus serrulata.
D5/1 Amelanchier botryapium.

Wild Crabs selected for resistance for Woolly Aphis (Staniland).

Row 58. Apple Stocks.

A261 Series 2 Wild Crab.
A276 Series 2 Wild Crab.
A277 Series 1 Wild Crab.
A260 Series 1 Wild Crab.
A277 Series 3 Wild Crab.
A262 Series 3 Wild Crab.
A263 Series 4 Wild Crab.
A264 Series 6 Wild Crab.

Row 58. Pyrus species.

D12 Amelanchier species, Montana.
D11 Amelanchier "John."

Row 58. Apple Stocks. Varieties of apple to test self-rooting capabilities.

A179 Medaille d'Or.
A97 Keswick Codlin.
A94 Kentish Codlin.

Row 59. Quince Stocks.

C4 Quince A1.
1

Row 60.

C3 Quince B.
C24 Vranja.

Commercial varieties of Pears to test self-rooting capabilities.

B16 Conference. Layered.
B15 Fertility.
B56 Durondeau.
B62 Dr. Jules Guyot.
B54 Emile d'Heyst.

Row 60. Apple Stocks.

A259 Stoke Edith Pippin (self-rooting apple).
AA5 Type III.
1
A36 Type VII.

Row 61. Quince Stock.

C1 Quince A.

PLOT X.

Railway.

25	LI	LI	LI	LI	LI	LII	LII	25
24	BXp	LII	BVI	LII	BIp	LII	BVII	24
23	LIII	LIII	LIII	LIII	LIII	LV	LV	23
22	BX	LV	BVIp	LV	BI	LV	BVIIp	22
21	LVI	LVI	LVI	LVI	LVI	LVII	LVII	21
20	BXp	LVII	BVI	LVII	BIp	LVII	BVII	20
19	LIX]	LIX	LIX	LIX	LIX	LX	LX	19
18	BX	LX	BVIp	LX	BI	LX	BVIIp	18
17	LXIII	LXIII	LXIII	LXIII	LXIII	LXV	LXV	17
16	BXp	LXV	BVI	LXV	BIp	LXV	BVII	16
15	LXVI	LXVIp	LXVI	LXVIp	LXVI	LXVIp	LXVI	15
14	BX	LIVp	BVIp	LIVp	BI	LXVIp	BVIIp	14
13	LIV	LIVp	LIV	LVIIIp	LVIII	LVIII*p	LVIII*	13
12	BVIp	LXIp	BI	LXIp	BXp	LVIIIp	BII	12
11	LXI	LXIp	LXI	LXIVp	LXIV	LXIVp	LXIV	11
10	BVI	LXVp	BIp	LXVp	BX	LXIVp	BIIp	10
9	LXVp	LXVp	LXIIIp	LXIIIp	LXIIIp	LXIIIp	LXIIIp	9
N 8	BVIp	LXp	BI	LXp	BXp	LXp	BII	8
7	LXp	LXp	LIXp	LIXp	LIXp	LIXp	LIXp	7
6	BVI	LVII*p	BIp	LVIIp	BX	LVIIp	BIIp	6
5	LVIIp	LVIIp	LVIp	LVIp	LVIp	LVIp	LVIp	5
4	BVIp	LVp	BI	LVp	BXp	LVp	BII	4
3	LVp	LVp	LIIIp	LIIIp	LIIIp	LIIIp	LIIIp	3
2	BVI D	LIIp	BIp C	LIIp	BX B	LIIp	BIIp A	2
1	LIIp	LIIp	LIp	LIp	LIp	LIp	LIp	1

Roman numerals represent variety of stock type number.
(L) = Bush Lane's Prince Albert. Rows 1 to 25, E and W.
(B) = Half Standard Bramley's Seedling. Rows A to D, N and S.
(p) = pruned trees.
* Equals 2 year trees planted 1920 as replacements.

PLOT XI. (i).

	h		g		f		e		d		c		b		a		
12	GI	I	GS	I	G51	II	GA	II	GXV	II	GXVI	II	GXIII	XI	GX	XI	12
11	III	III	III	III	III	III	III	III	II	II	II	II	XIV	XIV	XIV	XIV	11
10	GI	V	GS	V	G51	V	GA	V	GXV	V	GXVI	V	GXIII	XV	GX	XV	10
9	VII	VII	VI	VI	VI	VI	VI	VI	VI	VI	V	V	XVI	XVI	XIII	XIII	9
8	GI	VII	GS	VII	G51	VII	GA	VII	GXV	VII	GXVI	VII	GXIII	X	GX	X	8
7	X	X	X	X	IX	IX	IX	IX	IX	IX	IX	IX	XII	XII	XII	XII	7
6	GI	X	GS	X	G51	X	GC	X	GXV	XII	GXVI	XII	GXIII	XII	GX	XII	6
5	XIII	XIII	XIII	XIII	XIII	XIII	XII	XII	XII	XII	XII	F	XII	XII	VII	VII	5
4	GI	XIII	GS	XIII	G51	51	GC	51	GXV	F	GXVI	F	GXIII	IX	GX	IX	4
3	XV	XV	XV*	XV	XV	XV	XV	XV	E	E	C	C	VI	VI	V	V	3
2	GI	XVI	GS	XVI	G51	XVI	GC	XVI	GXV	XVI	GXVI	XVI	GXIII	III	GX	III	2
1	IV	IV	IV	VIII	VIII	VIII	XI	XI	XI	XI	A	A	I	I	II	II	1

N ↓ — Row →

Bottom Half (nearest Road).
PLOT XI (L) = Lane's Prince Albert (Bush).
(G) = Grenadier (Half Standard).
(S) = Northern Spy.
Roman numerals represent variety of stock (type number).
I to XVI = Types of "Paradise" Stock.
A, C, D, F. H, 51 = "Crab" and "Free" Stocks.
* Two year tree planted Spring 1921.

PLOT XI. (ii.)

Top Half. Railway.

25	IV	IV	IV	IV	VIII	VIII	VIII	XI	XI	XI	XVI	XVI	II	II	I	I	25
24	GX	XVI	GXIII	XVI	GA	XVI	GXVI	XVI	GF	XVI	GXV	XVI	G51	III	GI	III	24
23	XV	XV	XV	XV	XV	A	A	A	C	C	E	E	IX	IX	VII	VII	23
22	GX	XIII	GXIII	XIII	GA	51	GXVI	51	GF	H	GXV	H*	G51	V	GI	V	22
21	XIII	XIII	XIII	XIII	XIII	XIII	XII	XII	XII	XII	XII	XII	X	X	VI	VI	21
20	GX	X	GXIII	X	GA	X	GXVI	X	GF	XII	GXV	XII	G51	XII	GI	XII	20
N 19	X	X	X	X	IX	IX	IX	IX	IX	IX	IX	IX	XII	XII	XII	XII	19
18	GX	VII	GXIII	VII	GC	VII	GXVI	VII	GF	VII	GXV	VII	G51	XIII	GI	XIII	18
17	VII	VII	VI	VI	VI	VI	VI	VI	VI	VI	V	V	XIV	XIV	XIV	XIV	17
16	GX	V	GXIII	V	GC	V	GXVI	V	GF	V	GXV	V	GS	F	GI	XV	16
15	III	III	III	III	III	III	III	III	II	II	II	II	XV	XV	XVI	XVI	15
14	GX	I	GXIII	I	GC	II	GXVI	II	GF	II	GXV	II	GS	XVI	GI	XVI	14
13	I	I	I	I	I	I	I	I	I	I	I	I	VIII	VIII	IV	IV	13

See explanation—Roman Figures, etc.— previous page, *re* this Plot.

PLOT XII.

25	wI	bI	wI	bI	wII	bII	wII	bII	wIII	bIII	25
24	bI	wI	bI	wI	bII	wII	bII	wII	bIII	wIII	24
23	wV	bV	wV	bV	wIV	bIV	wIV	bIV	wIII	bIII	23
22	bV	wV	bV	wV	bIV	wIV	bIV	wIV	bIII	wIII	22
21	wVI	bVI	wVI	bVI	wVII	bVII	wVII	bVII	wIX	bIX	21
20	bVI	wVI	bVI	wVI	bVII	wVII	bVII	wVII	bIX	wIX	20
19	wXII	bXII	wXII	bXII	wX	bX	wX	bX	wIX	bIX	19
18	bXII	wXII	bXII	wXII	bX	wX	bX	wX	bIX	wIX	18
17	wXIII	bXIII	wXIII	bXIII	wXV	bXV	wXV	bXV	wXVI	bXVI	17
16	bXIII	wXIII	bXIII	wXIII	bXV	wXV	bXV	wXV	bXVI	wXVI	16
15	w51	b51	w51	b51	wF	bF	wF	bF	wXVI	bXVI	15
14	b51	w51	b51	w51	bF	wF	bF	wF	bXVI	wXVI	14
13	wVIII	bVIII	wVIII	bVIII	wVIII	bVIII	wXIV	bXIV	wE	bE	13
12	bXVI	wXVI	bXI	wXI	bXI	wXI	bXIV	wXIV	bE	wE	12
11	wXVI	bXVI	wXI	bXI	wXI	bXI	wXIV	bXIV	wE	bE	11
10	bXVI	wXVI	bXV	wXV	bXV	wXV	bXIII	wXIII	bXIII	wXIII	10
9	wXVI	bXVI	wXV	bXV	wXV	bXV	wXIII	bXIII	wXIII	bXIII	9
8	bIX	wIX	bX	wX	bX	wX	bXII	wXII	bXII	wXII	8
7	wIX	bIX	wX	bX	wX	bX	wXII	bXII	wXII	bXII	7
6	bIX	wIX	bVII	wVII	bVII	wVII	bVI	wVI	bVI	wVI	6
5	wIX	bIX	wVII	bVII	wVII	bVII	wVI	bVI	wVI	bVI	5
4	bIII	wIII	bIV	wIV	bIV	wIV	bV	wV	bV	wV	4
3	wIII	bIII	wIV	bIV	wIV	bIV	wV	bV	wV	bV	3
2	bIII	wIII	bII	wII	bII	wII	bI	wI	bI	wI	2
1	wIII	bIII	wII	bII	wII	bII	wI	bI	wI	bI	1

b = Bramley Seedling.
w = Worcester Pearmain.
Roman numerals and variety of root stock (type number).
E, F, and 51 = Selected layered "Crabs."
Rows 1 to 15 are pruned.
Rows 16 to 25 are unpruned.

PLOT XIII.

Railway.

25	w51	B51	w51	B51	wE	BF	wXI	BVIII	wXVI	BVIII	25
24	B51	w51	B51	wE	BF*	wF	BVIII	wXI	BVIII	wXVI	24
23	wXIII	BXIII	wXIII	BXIII	wXV	BXV	wXV	BXV	wXVI	BXVI	23
22	BXIII	wXIII	BXIII	wXIII	BXV	wXV	BXV	wXV	BXVI	wXVI	22
21	wXII	BXII	wXII	BXII	wX	BX	wX	BX	wIX	BIX	21
20	BXII	wXII	BXII	wXII	BX	wX	BX	wX	BIX	wIX	20
19	wVI	BVI	wVI	BVI	wVII	BVII	wVII	BVII	wIX	BIX	19
18	BVI	wVI	BVI	wVI	BVII	wVII	BVII	wVII	BIX	wIX	18
17	wV	BV	wV	BV	wIV	BIV	wIV	BIV	wIII	BIII	17
16	BV	wV	BV	wV	BIV	wIV	BIV	wIV	BIII	wIII	16
15	wI	BI	wI	BI	wII	BII	wII	BII	wIII	BIII	15
14	BI	wI	BI	wI	BII	wII	BII	wII	BIII	wIII	14
13	wI	BI	wI	BI	wII	BII	wII	BII	wIII	BIII	13
12	BI	wI	BI	wI	BII	wII	BII	wII	BIII	wIII	12
11	wIV	BIV	wIV	BIV	wV	BV	wV	BV	wIII	BIII	11
10	BIX	wIX	BIV	wIV	BV	wV	BV	wV	BIII	wIII	10
9	wIX	BIX	wVII	BVII	wVII	BVII	wVI	BVI	wVI	BVI	9
8	BIX	wIX	BVII	wVII	BVII	wVII	BVI	wVI	BVI	wVI	8
7	wIX	BIX	wX	BX	wX	BX	wXII	BXII	wXII	BXII	7
6	BIX	wIX	BX	wX	BX	wX	BXII	wXII	BXII	wXII	6
5	wF	BF	wXV	BXV	wXV	BXV	wXIII	BXIII	wXIII	BXIII	5
4	BF	wF	BXV	wXV	BXV	wXV	BXIII	wXIII	BXIII	wXIII	4
3	wXI	BXI*	wXI	BXI*	wXVI	BXVI	wXIV*	BXIV*	w51	B51	3
2	BXI*	wXI	BXI*	wXVI	BXVI	wXVI	BXIV*	wXIV	B51	w51	2
1	wXI	BXI*	wXI	BXVI	wXVI	BXVI	wXIV	BXIV	w51	B51	1

Road.

B = Bramley Seedling.
w = Worcester Pearmain.
Roman numerals = variety of root stock (type number).
E, F, and 51 = Selected layered free and crab stocks.
* = Trees planted spring 1921 as two year trees.

PLOT XIV.

Railway.

25	wV	bI	wV	bI	wVI	bII	wVI	bII	wIV	bX	25
24	bI	wV	bI	wV	bII	wVI	bII	wVI	bX	wIV	24
23	wV	bI	wV	bI	wVI	bII	wVI	bII	wIV	bX	23
22	bI	wV	bI	wV	bII	wVI	bII	wVI	bX	wIV	22
21	wI	bV	wI	bV	wII	bVI	wII	bVI	wIV	bX	21
20	bV	wI	bV	wI	bVI	wII	bVI	wII	bX	wIV	20
19	wI	bV	wI	bV	wII	bVI	wII	bVI	wIV	bX	19
18	bV	wI	bV	wI	bVI	wII	bVI	wII	bX	wIV	18
17	wX	bIV	wX	bIV	wVII	bIII	wVII	bIII	wIII	bVII	17
16	bIV	wX	bIV	wX	bIII	wVII	bIII	wIII	bVII	wIII	16
15	wX	bIV	wX	bIV	wVII	bIII	wVII	bVII	wIII	bVII	15
14	bIV	wX	bIV	wX	bIII	wVII	bIII	wIII	bVII	wIII	14
13	wIII	bVII	wIII	bIII	wVII	bIII	wVII	bVII	wIII	bVII	13
12	bVII	wIII	bVII	wVII	bIII	wVII	bIV	wX	bIV	wX	12
11	wIII	bVII	wIII	bIII	wVII	bIII	wX	bIV	wX	bIV	11
10	bVII	wIII	bVII	wVII	bIII	wVII	bIV	wX	bIV	wX	10
9	wIII	bVII	wIII	bIII	wVII	bIII	wX	bIV	wX	bIV	9
8	bX	wIV	bVI	wII	bVI	wII	bV	wI	bV	wI	8
7	wIV	bX	wII	bVI	wII	bVI	wI	bV	wI	bV	7
6	bX	wIV	bVI	wII	bVI	wII	bV	wI	bV	wI	6
5	wIV	bX	wII	bVI	wII	bVI	wI	bV	wI	bV	5
4	bX	wIV	bII	wVI	bII	wVI	bI	wV	bI	wV	4
3	wIV	bX	wVI	bII	wVI	bII	wV	bI	wV	bI	3
2	bX	wIV	bII	wVI	bII	wVI	bI	wV	bI	wV	2
1	wIV	bX	wVI	bII	wVI	bII	wV	bI	wV	bI	1

Road.

b = Bramley Seedling.
w = Worcester Pearmain.
Roman numerals = variety of root stock (type number).

PLOT XV.

Railway.

	4	3	2	1	
31	7	8	7	7	31
30	8	6	8	7	30
29	6	5	J.	J.	29
28	7	5	7	J.	28
27	4	4	My.	My.	27
26	6	3	6	My.	26
25	3	3	Btn.	Btn.	25
24	6	2	5	Btn.	24
23	2	2	C.	C.	23
22	5	2	5	C.	22
21	1	2	C.M	CM.	21
20	4	1	4	C.M	20
19	1	1	Bs.	Bs.	19
18	3	1	3	Bs.	18
17	7	8	P.	Bs.	17
16	8	7	8	P.	16
15	7	7	P.	P.	15
14	8	6	7	J.	14
13	6	6	J.	J.	13
12	7	5	7	My.	12
11	5	5	My.	My.	11
10	6	4	6	Btn.	10
9	4	4	Btn.	Btn.	9
8	5	3	5	C.	8
7	2	3	C.	C.	7
6	4	2	4	CM.	6
5	2	2	CM.	CM.	5
4	4	2	3	Bs.	4
3	1	1	Bs.	Bs.	3
2	3	1	3	P.	2
1	1	1	P.	P.	1
	4	3	2	1	Row.

Road.

Pear and Plum Stock Trials.

Plums.

P. = Victoria on Pershore.
Bs. = ,, ,, Brussels.
CM. = ,, ,, Common Mussel.
C. = ,, ,, Common Plum.
Btn. = ,, ,, Brompton.
My. = ,, ,, Myrobolan.
J = ,, ,, St. Julien.

Pears.

1 = Fertility on Angers Quince.
2 = ,, ,, Portugal Quince.
3 = ,, ,, Common Pear.
4 = ,, ,, Wild Pear.
5 = ,, ,, Hawthorn.
6 = ,, ,, Mountain Ash.
7 = ,, ,, Service.
8 = ,, ,, White Beam.

N.B.—Trees 3 and 28 in Row 1 are removed.

PLOT XVI.

31	Ast. / J	C / B	Ast. / con.	C / W	DF / Wi.	C / Bis.	B / L	B / L	L / B	L / B	31
30	Ast. / con.	C / C	Ast. / J	C / W	Bl. / S	C / con.	B / L	B / L	L / B	L / B	30
29	Ast. / J	C / B	Ast. / con.	C / W	DF / con.	C / Bis.	B / L	B / L	L / B	L / B	29
28	Ast. / con.	C / B	Ast. / J	C / W	Bl. / con.	C / B	L / W	L / W	W / B	W / B	28
27	Ast. / J	C / C	Ast. / con.	C / W	DF / Q	C / S	L / W	L / W	W / B	W / B	27
26	Ast. / con.	C / B	Ast. / J	C / W	Bl. / S	C / B	L / W	L / W	W / B	W / B	26
25	L / L	C / C	L / W	C / D	DF / Wi.	C / S	W / L	W / L	B / W	B / W	25
24	B / W.T.	C / B	B / W.T.	C / X.P.	Bl. / con.	C / con.	W / L	W / L	B / W	B / W	24
23	L / W	C / Gl.	L / L	C / Br.R	DF / con.	C / Bis.	W / L	W / L	B / W	B / W	23
22	B / A.E.	C / Stu.	B / con.	C / X.P.	Bl. / S	C / con.	B / B	B / con.	L / L	L / con.	22
21	Bau. / Gros.	C / Gl.	L / W	C / Br.R.	DF / Q	C / Bis.	B / B	B / con.	L / L	L / con.	21
20	B / W.T.	C / Stu.	B / A.E.	C / X.P.	Bl. / con.	C / B	B / B	B / con.	L / L	L / con.	20
19	Bau. / O.N.	C / E.Vic.	L / L	C / Bl.	DF / Wi.	C / S	L / B	L / B	W / W	W / con.	19
18	B / con.	C / Al.	B / W.T.	C / C	Bl. / S	C / B	L / B	L / B	W / W	W / con.	18
17	Bau. / Gros.	C / E.Vic.	L / N	C / Bl.	DF / con.	C / S	L / B	L / B	W / W	W / con.	17
16	B / A.E.	C / Al.	B / con.	C / C	Bl. / con.	C / con.	W / W	W / W	L / L	L / L	16

PLOT XVI.—*continued.*

15	Bau.	C	L	C	DF	C	W	B	B	L	15
	con.	E.Vic.	W	Bl.	Q	Bis.	W	B	B	L	
14	B	C	B	C	Bl.	C	W	B	B	L	14
	W.T.	Al.	A.E.	C	S	con.	W	B	B	L	
13	Bau.	C	L	C	DF.	C	W	B	B	L	13
	Gros.	Gl.	L	X.P.	Wi.	Bis.	W	B	B	L	
12	B	C	B	C	Bl.	C	W	W	B	B	12
	con.	Stu.	W.T.	Br.R.	con.	B	B	B	L	L	
11	Bau.	C	L	C	DF	C	W	W	B	B	11
	con.	Gl.	N	X.P.	con.	S	B	B	L	L	
10	B	C	B	C	Bl.	C	W	W	B	B	10
	A.E.	Stu.	con.	Br.R.	S	B	B	B	L	L	
9	Bau.	C.	L	C	DF	C	B	B	L	L	9
	Gros.	Gl.	W	X.P.	Q	S	W	W	W	W	
8	B	C	B	C	Bl.	C	B	B	L	L	8
	W.T.	Stu.	A.E.	Bl.	Con.	con.	W	W	W	W	
7	Bau.	C	L	C	DF	C	B	B	L	L	7
	con.	Al.	L	C	Wi.	Bis.	W	W	W	W	
6	B	C	B	C	Bl.	C	L	L	W	W	6
	con.	E.Vic.	W.T.	Bl.	S	con.	L	con.	L	L	
5	Bau.	C	L	C	DF	C	L	L	W	W	5
	Gros.	Al.	N	C	con.	Bis.	L	con.	L	L	
4	B	C	B	C	Bl.	C	L	L	W	W	4
	A.E.	E.Vic.	A.E.	Bl.	con.	B	L	con.	L	L	
3	Bau.	C	L	C	DF.	C	W	W	B	B	3
	con.	Al.	W	C	Q	S	W	con.	B	con.	
2		C	B	C	Bl.	C	W	W	B	B	2
		E.Vic.	W.T.	Bl.	S	B	W	con.	B	con.	
1		C	L	C	DF	C	W	W	B	B	1
		Al.	L	C	Wi.	S	W	con.	B	con.	
	k	j	h	g	f	e	d	c	b	a	

Road.....

N.B.—Details re Plan given in pages 44–50.

Section III.

Programme of Research, with Progress Reports upon Particular Items.

Since the whole programme of research and results up to date were reviewed and summarised in the Annual Report for 1922, it is proposed in the future to give progress reports upon lines of work which have reached a sufficiently advanced stage to create interest and arouse discussion, but which are not yet mature enough for a detailed report.

Thus, whilst this section of our Annual Report will still largely consist of short summaries under the various headings of our Research Programme, it will also include signed articles by individual Members of Staff upon the development of particular aspects.

At the same time, we would ask our readers not to forget that the full detailed reports setting forth the evidence for our reasoned conclusions are available from time to time, alike for the grower and our fellow research workers, in the *Journal of Pomology and Horticultural Science*, which a year ago was re-established as an official organ of the Horticultural Research Stations, with a body of associated Editors widely representative of scientific agricultural thought. Quarterly numbers of that *Journal*, published by Headley Brothers, 18, Devonshire Street, Bishopsgate, E.C.2, are obtainable, post free for the Annual Subscription of 15s. Every grower who wishes to be well informed as to the activities of Horticultural Research will find this indispensable.

This year detailed reports have appeared in this or other journals upon "The Influence of Root Stock upon the Tree Fruits," "The Resistance of Apple Stocks to attacks of the Green Apple Aphis," and "Tests of Fungicides on Apple Trees (II.)". Popular accounts, designed to serve the purpose of "Farmers'

Bulletins," have been published under the titles "Some Notes on Stocks for Plums," and "Notes on Apple Pruning." Since October, 1921, five such Bulletins have been reprinted from the *Kent Farmers' Union Journal*, and they have served a very useful purpose.

A complete list of the detailed reports already published appears at the end of this section.

FRUIT RESEARCH.

I. In relation to the Tree Fruits.

POMOLOGICAL.

A.—ROOT STOCK INVESTIGATIONS.

Each year the accumulation of data seems both to strengthen and widen the evidence demonstrating the vital importance of root stock influence to the tree raiser, fruit grower, and research worker alike.

Whilst enthusiasts have possibly at times been tempted to claim too much for the value of root stock influence, all our evidence goes to emphasise that this basic factor exerts upon the performance of the tree a measurable influence which must not be ignored by any of those concerned.

At the present time, the only way in which we have succeeded in controlling this factor, which contributes to the inconclusive results of field trials, has been by the re-establishment of "clones" or families of stocks raised vegetatively from a single parent.

As the years pass the greater uniformity of stocks and trees obtained by this method becomes more and more striking. For these reasons we have striven to obtain and emphasise the value of series of vegetatively raised stocks.

Whether this is the only solution time alone can show. The frequently repeated tradition, especially on the continent, that certain lines of seedlings of Apples, Pears and Plums are uniform, has to be fully sifted. The collections sent to East Malling to substantiate this claim exhibit very contradictory evidence,

but so far none have been found to approach closely vegetatively raised stocks in uniformity. Further investigations along this line have been undertaken at Long Ashton in the case of Apples.

(1) With Apples.

A general review of the progress of this work and of our early conclusions was given in the last Annual Report. Since then many of the figures illustrating these and other results have been published in detail. It is therefore unnecessary to recapitulate. East Malling has now under observation and control about seventeen trial acres of Apple trees of eleven varieties upon selected root stocks on seven different soils.

A considerable unit of trees (often amounting to thirty-two) has been allowed, in order to make frequently repeated plots at each centre possible.

Upon this material records are still being kept of tree weight at planting, annual growth and girth measurements, number and position of bloom buds, time of blossom opening, set of fruit, fruit drops, ultimate crop, and size and quality of fruit.

Notes upon such things as roothold, habit of growth, and leaf area are also being continued from time to time.

Stock effect generally appears to be relatively similar with different varieties and upon different soils, though its extent may be increased or reduced by external conditions. Whilst this makes it clearly impossible to recommend any one stock for any particular purpose in all situations, we have already been able to make general suggestions for the use of stocks, which should guide any grower who knows his local conditions.

(2) With Pears.

(*a*) *Quince Stocks.*

Both in the Nursery and in the Plantation, the "lack of affinity" between certain kinds of Quince Stocks and even those varieties of Pear commonly budded direct on Quince has been most strikingly demonstrated. In the nursery, over a succession of seasons, many of the buds have consistently either failed to grow altogether or produced weakling trees upon these unsuitable Quinces. In the developing Plantations, even those apparently

good trees, which had with difficulty been obtained in the Nursery, have frequently died out.

These difficulties, and the fact that even upon the best kinds of Quince many varieties of pear have to be "double worked," have encouraged the development of certain other lines of work, with regard to the selection of stocks for Pears.

(*b*) *"Free" Pear Stocks.*

The multiplication of selected seedling Pears by methods of vegetative propagation has been proceeded with. A number of these selections are now rooting readily from layers, and the layers have shewn that they stand transplanting as well as Apple Stocks.

A large number of new selections have been made in the hope of obtaining a series of roots capable of exerting a wide range of influence.

A considerable batch of vegetatively raised Pear stocks were budded with Dr. Jules Guyot last summer, so that some indications should soon be available. The experiments designed to test the limits of intergrafting between Pears and other species and genera are being developed. It is hoped that out of these experiments some stocks suitable for particular purposes may be found.

(3) With Plums and Peaches.

A general summary of a popular nature has recently been published embodying the early results of these investigations.

Some six acres of young Plum trees, comprising a dozen varieties upon a wide range of stocks, embracing at least four species, are under close observation.

The early records give promise of much more striking results than were expected, especially with regard to stock effect upon the time and habit of blooming of individual varieties. With the stocks at present in use, the control of vigour, though distinct, is not so great or uniform as in the case of Apples.

The "lack of affinity" between certain root stocks and scions, already mentioned in the case of Pears, is still more striking in the case of Plums and Peaches.

A preliminary trial of Peaches in pots is made possible this year by the completion of the Orchard House. Some eight stocks are included in the trial.

(4) With Cherries.

The work is being continued as outlined in the last report. A forward trial of Morello Cherries worked on layers of six selected sweet cherry stocks and of two Mahalebs has now been planted, and several more layered stocks have been budded with Morello to extend the trial. At the same time layers of seven selected sweet cherry stocks have been worked standard high ; the varieties chosen for this purpose are Early Rivers, Napoleon Bigarreau, and Florence.

It is interesting to note that the maiden Morellos on Mahaleb stocks are very much larger trees and in every way more vigorous than any of the Morellos on sweet cherry stocks ; the same applies to a few two year old trees now available for comparison. The six selected sweet cherry stocks on which the above-mentioned Morellos were planted out this winter already show very striking differences in root system.

(5) Study of Contributory Factors affecting Root Development and Influence.

Various aspects of this problem such as :—

(i.) The effect of the scion on the root stock,
(ii.) The effect of different treatments of the root prior to planting,
(iii.) The depth and the methods of planting,
(iv.) The effect of branch pruning upon the roots,

have now been under analytical study for various periods. Though it is yet impossible to draw final conclusions and give them a practical application, many of the results seem sufficiently interesting and suggestive to warrant the inclusion in this report of a review of the experiments up to date. This article appears on a later page.

B.—Double Working of Apples and Pears.

The planting of these trials is now completed until some definite indications suggest lines for further work.

Of Apples, some 350 trees, from two to five years old, are now available. Records similar to those for other trees are being kept on this plot. Whilst combinations of varieties of extreme difference have been used, results, though definite, are not yet

striking. Of Pears also, some 300 trees, now from one to four year old, have been planted. Striking differences between varieties in their value as intermediates have already been found, and seem to bear no relation to their vigour. Here again similar records are being kept.

C.—Pruning Experiments.

(1) *With Apples.*

Besides three reports on this work, including a second popular account issued in 1923, a summary of the results was given in the last annual report. The results continue to justify the recommendations made, especially that concerning the light pruning of "filler" trees.

The following individual tree records are kept each year:—Height and spread of tree, and girth of stem below the branches; weight of prunings, and number of laterals and leaders shortened in pruning; number and weight of picked fruits and windfalls (recorded separately); number of blossom buds (except of some unpruned trees); and, of six varieties, the number and weight of scabbed fruits, and number of mildew infections. Canker infections are recorded wherever they occur. Of some varieties the picked fruit is ring graded to show the effect of pruning on size. Besides elucidating the effects of various methods of pruning, these accumulated records will be available for a study of the economic returns from the plantation, and for working out the experimental error with trees rigidly selected at planting, but on mixed or unknown stocks.

(2) *With Pears.*

Six varieties of Pears on a known Quince root, now two years old, will be subjected for the first time in 1924 to various pruning treatments, with a view to studying their response.

(3) *With Plums.*

The pruning of Victoria and Czar Plums at different seasons of the year, with a view to selecting the best periods for avoiding infection with Silver Leaf (*Stereum Purpureum*), has been undertaken. Also various degrees of pruning are being tested in the same connection.

D.—Manuring of Apples.

The plots concerned have now been under treatment for four years. The main object is to test the average English Growers' routine methods of manuring his plantations in comparison with the use of Green Manures, supplemented with chemical manures when deemed necessary.

Plots XIII. and XIV. both contain Bramley's Seedling and Worcester Pearmain on eight different varieties of rootstock. These trees are being used for the trial. Both plots are intercropped with similar varieties of Raspberries to which reference is made elsewhere.

Plot XIII. has received alternate year dressings of Shoddy (1½ tons), and London Dung (12-15 tons). In addition, the Raspberries and other interplanted crops have received light spring or summer dressings of various concentrated organic fertilisers. Plot XIV. has received no such dressings since the beginning of 1919, previous to which time both plots had been similarly cropped and manured for at least seven years. Subsequently Plot XIV. has received nothing at all but three non-leguminous green manure crops (Mustard, Cabbage and Rape). Intercropping was the same on both plots. From the end of 1922 there has been no intercropping on either plot, with the exception of the raspberries.

From 1920 onwards the influence of the different treatments has been conspicuous upon the vegetable intercrops. The wet summer of 1920, when onions were being grown as an intercrop, provided a curious result. Though the onions on the manured plot (XIII.) showed much more vigour and continued growth than those on the " Green Manure " plot (XIV.), the latter dried off early in the season and actually gave a greater weight of marketable crop. Plot XIII., owing to seasonal conditions, gave a higher percentage of " thick-necked " onions.

The following year Early Potatoes, Eclipse, gave a more normal result. Plot XIII. gave an additional 11 cwts. per acre.

In 1922, the crop of cabbage, though good on both plots, appeared to be considerably larger on Plot XIII. No actual record could be made of the crop weight, since the cabbage planted on Plot XIV. was designed for ploughing in as a green manure. That on Plot XIII. was harvested.

The Raspberries upon these plots have only cropped for one season (1923), and the curious result is recorded elsewhere in this report.

The results with Apple Trees are to date not very dissimilar. An analysis of wood growth during the three years (1920-22), indicates that up to the present the manuring of Plot XIII. has had no decisive results in favour of increasing vigour.

Allowance was made in the original plans for variation in treatment of Plot XIV. in case it should fall rapidly behind Plot XIII. in vigour, as many might have expected. If and when Plot XIV. fell fifty per cent. behind Plot XIII. in vigour, it was to receive dressings of chemical fertilisers, to see whether they, together with the better resulting green crops, would restore vigour. Up to the time of writing there is little indication of such a falling off. With one consistent exception (the trees of both Bramley and Worcester, on Doucin Type II.), the trees on the green manured plot have from the first year been somewhat ahead of those on Plot XIII. in length of woodgrowth.

The girth of stem measurements taken at the end of 1923 indicate that the difference may now be slightly less than a year ago. Measurements of length of 1923 wood growth could not be obtained in time for this report.

Close examination of our detailed records shows that this difference in favour of Plot XIV. is at least in part due to the accidental planting of trees slightly heavier on the average on the unmanured plot. At the same time it is worth noting that in only one case—that of the trees on Doucin—has the consistent manuring on Plot XIII. so far put those trees ahead of their fellows on Plot XIV. in length of wood growth.

Up to the present, of course, the crops on both plots have been inconsiderable ; but in the quantity and quality of fruit so far produced the manuring has shown no advantage, if anything the reverse.

E.—Variety Trials.

Considerable collections of Apples, Pears, Plums and Cherries have been assembled and are being worked upon known root stocks, so that records may be kept upon their relative times of blossoming, habit of growth, cropping capabilities, and disease

resistance under our conditions. It is hoped to give a complete index to these collections in Section II. of next year's report.

Physiological.

The fundamental causes of root stock influence and the principles underlying the vegetative propagation of woody plants are the subject of physiological study. Dr. Knight reports that in an attempt to find a physiological basis of difference, investigations of the water relations of the apple stocks and varieties have been continued during 1923. Small differences have been found between Types I. and IX., and work was begun upon a named variety grafted on these two stocks. No evidence has yet been obtained to suggest that the differences between the water relations of the two stocks are transmitted to the scion. The differences, however, are small, and a large number of experiments are required before definite conclusions can be drawn. The work will be extended in 1924.

The first records of the field experiments (outlined in the last report), designed as a primary analysis of stock influence, indicate that the number of trees used was insufficient. These experiments are therefore being duplicated where possible, and plantations will be established in 1924, with sets of trees raised as follows :—

(*a*) Trees in which several buds of the same scion are worked on one stock. These should shed light on the question of whether quantitative nutritional factors are operative.

(*b*) Trees consisting of *two* root systems of different varieties and *one* scion. These should reveal whether the characters induced by stocks can be blended.

(*c*) Double worked trees with a piece of a stock as intermediate. These may give information as to whether stock influence is due to stem character or to root absorbing capacity.

The work on propagation by wood cuttings has been continued and extended. The results have been similar to those previously obtained, and continue to be encouraging as to the possibilities of acceleration, the difference of degree being probably a matter of season. In view of this it is felt that repetition should be continued for a while before a definite report is made.

II. In relation to the Small Fruits.

Pomological.

A.—Black Currants.

A comprehensive review of the work appeared in last year's annual report under the following headings :—

(*a*) Variety Trials.
(*b*) The " Running Off " of the Fruit.
(*c*) Testing various " Strains."
(*d*) Raising New Varieties.
(*e*) Manurial Trials.
(*f*) Pruning.

In the main, it is only necessary to report that activities are continuing in all these directions. As mentioned elsewhere, there has been a further extension of the variety trials to other soils and conditions. Several supposed new varieties have been added to our collection.

The work of raising new varieties is reaching a very interesting stage. Self-pollinated Seedlings of the second generation from the principal varieties have now been raised. Some extremely interesting forms have appeared, and a detailed study of the inheritance of the characters exhibited is being made.

Seedlings of Boskoop Giant, Goliath (Victoria type), and Baldwin usually resemble the parent more or less closely; but seedlings of French (Merveille de la Gironde), and Seabrook's show a large percentage of curious forms not hitherto seen in cultivation. Though we have failed to separate these two varieties botanically, inheritance characters show that they are not identical but almost certainly related, since several of the same forms appear in the selfed seedlings of both.

B.—Raspberries.

The report of progress this year takes the form of a signed article, on a later page.

C.—Gooseberries.

Material of the selected dessert varieties is still being raised for the projected pruning and manurial trials. Many of the parent bushes fruited for the first time last year and revealed the fact

that the same chaos exists in the nomenclature of the gooseberry as in other small fruits.

D.—The Variety Collections of Red Currants and Strawberries.

These have now been added to, and the original plants are in their second year.

III. In relation to Propagation Problems.

These problems are this year dealt with, in considerable detail, in a signed article, on a later page.

IV. In relation to Diseases and Pests.

Since the 1922 Annual Report was published, East Malling has been enabled to make two additions to Staff which will greatly facilitate these lines of work. We are now in a position to carry out Laboratory investigations, particularly into certain problems of diseases and pests which have inevitably arisen out of the root stock and variety trial work with regard to questions of resistance, susceptibility, and the transmission, by grafting, of such qualities.

At the same time the Pomological investigations of spraying and other methods of control are being continued in collaboration with the new workers.

Although it is difficult and even undesirable to separate many of these lines of work "departmentally," they are summarised below under the headings "Pathological" and "Entomological," according to the workers chiefly concerned.

(*a*) Pathological.

A.—Fungicidal Spraying on Apples.

Two reports have now been published on this subject, the second in the December number of the *Journal of Pomology*. In addition to the fungicidal value of the sprays, special attention has been paid to their other effects on the tree, such as influences on growth and fruitfulness, and the relation these bear to the

effects of various methods of pruning. A signed article dealing with the results obtained in 1923 appears on a later page. This second series of tests is being conducted on trees in commercial plantations, by the kind permission of Messrs. Tolhurst, of Ditton Court Farm, and Hodgins, of Egerton.

9.—Crown Gall.

The appointment of Dr. Wormald as Pathologist at East Malling has greatly helped the collaboration hitherto arranged. A detailed joint paper on the results so far obtained is ready for publication.

An organism has now been isolated from Apple Galls, and this shows in preliminary cultural and inoculation experiments affinities with the Crown Gall organism of America.

Observations on galled and clean trees, specially planted for the purpose, have failed to reveal any influence of Crown Gall on the growth and blossoming of the tree. It is felt that, if measurable effects are to be found, it will only be through direct laboratory inoculations, which should now be possible for the first time.

Clear indications have been seen from the first that there are different degrees of resistance and susceptibility to Crown Gall amongst the various root stocks. Figures also seem to demonstrate beyond doubt an influence of the scion on the susceptibility of the stock; some scions appear consistently to render the stock more susceptible, whilst others make it relatively more resistant.

Field methods of controlling Crown Gall have been attempted with promising results on two series of layered apple stocks. In each case a covering of Stockholm Tar over the wound at the base of the layer greatly reduced the proportion of stocks infected, and the development of the galls. Other dressings were less effective. Rough treatment and bruising of the stocks before planting greatly increased the number and size of the galls.

C.—Brown Rot.

Dr. Wormald has continued the researches on this subject which have already been in progress for many years. The work is being carried on along the following lines :

(i.) Comparative studies of the Brown Rot Fungi, occurring on various hosts in this country, in order to determine to what extent one host species is a source of infection for others.

(ii.) Comparison of the Brown Rot Fungi found in this country with those occurring in other countries.

(iii.) The biology of the Brown Rot fungus associated with, and apparently the cause of, a Blossom Wilt of Pear Trees.

D.—Bacterial Diseases of Plum and Cherry Trees.

Bacteria have been found associated with a leaf spot and die-back of Cherry trees and with a wilt of Plum shoots. A study of organisms isolated from the lesions is in progress. It appears to be this trouble which is causing considerable losses to cherry growers on farms in this and other districts in Kent.

E.—Possible Effects of Root Stock on susceptibility to Diseases of the Scion.

Field observations have long suggested that certain apple stocks prone to Canker pass on this susceptibility to the scion. It will now be possible to test this point by definite inoculations. Field records continue to be kept of the incidence of Apple Mildew, Black Spot, and Leaf Scorch upon trees worked on known stocks. These records must be allowed to accumulate for a few more seasons before definite conclusions can be drawn therefrom.

The problem of Silver Leaf, in which we have continued to collaborate with Mr. F. T. Brooks, of Cambridge, may be partly a root stock one. For this reason we have put at Mr. Brooks' disposal stocks true to name of the different varieties, and trees worked upon known root systems, for definite inoculation tests. These inoculations have been carried out partly at East Malling and partly at Cambridge. Mr. Brooks' recent report, already referred to, has a good deal to say about the susceptibility to Silver Leaf of our various Plum stocks. None of these stocks so far artificially inoculated have proved immune to invasion by *Stereum purpureum*, though two stocks, Myrobolan B. and Common Mussel, showed some degree of resistance. Immunity was hardly expected, and, as Mr. Brooks points out, this does not necessarily mean that the nature of the root stock after all has no influence upon the susceptibility of the tree. Indeed, both his observations

in East Anglia and the data collected from our own plantations at East Malling (and recently published) still seem to point quite clearly to the fact that some such indirect influence is at work. It is, however, rather in the building up of the tree and in the real changes that stock actually effects upon its habit and nature of growth that we are looking for improvement.

It must be some years yet before the results of these joint investigations can be known, but they are so designed as to test out fully the possibilities lying in this direction.

F.—Methods of Controlling Silver Leaf in the Field.

Besides the lines of investigation as to the possibilities of influencing the tree's general "make up" through root stock and nursery methods, mentioned above, various other lines of investigation are being pursued. Different methods and seasons for shaping and pruning young Plum trees are being tried. These experiments are now in their second season.

Various treatments in the field, such as the cutting out of silvered branches in the early stages, the dressing of wounds, the "ring" barking of silvered trees, and the use of certain manures and soil dressings are all being employed. Much data is being carefully collected and sifted, but it is too early days yet to make any definite recommendations.

G.—Raspberry Diseases.

For some years past various diseases of Raspberries and Loganberries, causing the death of the cane, have been prevalent. In the large collection of varieties which we have now acquired, several of these troubles have appeared. One, which appears to be serious, is being studied in some detail by a special temporary post-graduate worker.

The "Mosaic" disease, very common on Raspberries in this country, is the subject of a separate article on a later page.

H.—Hop Canker.

A species of Gibberella occurring on dead Hop "straps" has been found to give rise in cultures to a Fusarium resembling that associated with Hop Canker. A study of the fungus is being made.

As has been mentioned elsewhere, records upon the incidence of " Mosaic " Disease in Hops are being kept in the Experimental Gardens.

(b) Entomological.

(A) Study of Resistance of various Apple Stocks to attacks of certain Insect Pests.

(1) *Resistance to Green Apple Aphis (Aphis Pomi).*

The work which Mr. Massee began over two years ago on this subject, whilst he was working as a Research Scholar of the Ministry, has recently been fully reported on in the *Journal of Pomology*, Vol. III., No. 4.

The worker's primary object was to establish the fact whether or not there really existed different degrees of resistance to attack amongst different varieties of Apple stock and even amongst different individuals of the same variety, or whether it was merely a matter of chance that certain plants were not attacked. Data have definitely proved that certain varieties are actually much more highly resistant to attack and damage by Apple Aphis than others. Still further, that particular individuals from these varieties stand out as peculiarly resistant, though not immune.

The further problem naturally presented itself as to whether it would be possible to perpetuate these degrees of resistance by propagating a race of stocks raised vegetatively from the resistant parent. So far experiments seem to show this to be possible. Layers from resistant stools have maintained their resistance. The economic value of being able to lessen the chances of Green Aphis attack to young Apple Stocks is obvious, if such resistance remains constant. The matter has been pursued a step further in order to ascertain whether a stock resistant to such attack would in any way convey that resistance to the scion. As was only to be expected, no such influence has been apparent.

(2) *Resistance to Woolly Aphis (Eriosoma Lanigera).*

Since our last Annual Report was issued, Mr. L. N. Staniland, of the Imperial College of Science, has published Part I. of his work on the above subject.

Here again very striking differences in the degrees of resistance to attack both above and below ground have been shown to

exist. It is encouraging to find that though immunity is rare, resistance appears fairly common. The joint programme is continuing. Composite trees consisting of immune roots and susceptible scions and *vice versa* have been prepared for Mr. Staniland, and several varieties of Apple, which he has shown to be immune to attack, are being tested for their suitability as stocks. Finally, a beginning has been made with the joint effort to raise, test, and select as suitable for root stock purposes a new race of immune, ready rooting plants which combine other desirable characters of root influence.

Mr. M. B. Crane, of the John Innes Horticultural Institution, has sent his first batch of seedling stocks of the parentage Doucin (Type II.), crossed with Northern Spy, for testing both for their resistance and capabilities of rooting, etc.

B.—Black Currant Gall Mite.

(1) A detailed study of the life history of the Mite under local conditions is being carried on in conjunction with the series of spraying experiments in the field, the early results of which are reported upon on another page.

It is hoped to obtain more accurate information as to the local movements of the Mite so that control methods may be made the more effective.

(2) The question of the treatment of Black Currant cuttings before planting has also been under consideration and methods which have given promising preliminary results will be repeated.

(3) In connection with the Black Currant breeding work, certain of the new seedlings are being tested for their resistance to Mite attack by methods of direct infection.

Certain other Mites found on fruit bushes and trees are also being studied.

C.—"Reversion" in Black Currants.

Most of the Members of Staff are collaborating in some form or other with the investigations designed to elucidate the cause and so suggest methods of control of this most serious trouble. A series of experiments have now been in progress for two years to ascertain the possible correlation between Big Bud and "Reversion." Healthy bushes have been directly infected with

Mite to see whether "Reversion" could be induced. The Pomological Staff have for a similar period been trying to transmit "reversion" by methods of grafting, in-arching, etc., and to induce it by certain treatments. The physiologist has been watching the effects of upsetting the plant's normal metabolism. The fact that it is quite easy to cause a "temporary" Reversion on the plants inevitably prolongs the period of investigation.

Certain aspects of this work are by agreement being duplicated both at Long Ashton and East Malling, and it is felt that the time is yet hardly ripe for the publication of results and a survey of the whole field.

Our efforts at eradicating the trouble from young stock both by careful "roguing" of the parent bushes and subsequent examination in the Nursery rows have on the whole been very encouraging.

For instance, cuttings from a particular family of French Blacks (Merveille de la Gironde) in 1920, taken with normal commercial precautions, showed twenty-five per cent. of definite "reverts." Cuttings from the identical family, after two further years of careful roguing, showed no "reverts." Our cutting beds this year have, with one exception, shown practically no "reversion." That one exception seems attributable to the fact that parent bushes may apparently "revert" very rapidly, i.e., even between the time of summer roguing and the taking of cuttings. One bush so slipped through our fingers and gave us three per cent. "reverts" in our Goliaths, but these were easily traceable in the Nursery rows when in leaf.

We therefore think the double roguing of the parent bushes, first when they are coming into blossom and again when they are making their main leaf growth in July, to be well worth while. We have not found either method by itself completely efficient. The final precaution is the roguing of the Nursery bed by leaf characters; it is not a difficult method, once the eye knows what to look for.

D.—The Apple Blossom Weevil.

Investigations on the control of the Apple Blossom Weevil are being continued, and as mentioned elsewhere (*The Journal of the Kent Farmers' Union*, p. 30, July, 1922), the most practical

method of controlling this pest, under Malling conditions, is by trapping the weevils in sacking bands.

Recent work at Malling clearly indicates that the various other methods for controlling this pest, such as jarring the trees, the application of a lime wash, grease-banding, or the enclosure of fowls in the orchards, do not compare in practical value in young plantations. It is quite probable that a spray which will, amongst other things, remove rough bark, applied in the dormant season to old and neglected trees, may be of considerable value. Since it has become evident that large numbers of weevils are attracted to the bands, where tree trunks are in a clean and smooth condition and do not afford many other opportunities for hibernating during the winter months, it has become necessary to extend the programme, and the following experiments are in progress :—

(1) To determine the most suitable seasons and methods for applying and removing the sacking bands.

(2) To determine whether the weevils on entering the bands, remain there during the whole of the insect's period of hibernation.

(3) To determine what percentage of the weevils so caught after the oviposition season are "spent females," and what percentage are those which will lay eggs the following season.

Work is also being continued on the Life History and Parasitic Enemies of the Weevil, but up to the present the latter appear to be of very little economic importance as a means of control of this particular pest in this district.

HOP EXPERIMENTS.

(*a*) New Varieties.

The aims of Mr. E. S. Salmon in raising his new seedlings, the amount of material accumulated, and the methods by which the varieties and their individual performances are annually passed under review, were fully dealt with in the last Annual Report. Some of the results already attained were also summarised from Mr. Salmon's own reports. Since then, he has published the "Sixth Report on the Trials of New Varieties of Hops," and so brings matters one stage further.

One of the interesting features of that report is the account of the " Mosaic " disease of the hop as it has affected these trials at East Malling. Some details are given of the attempt to control the disease by means of pulling infected bines. The conclusion is arrived at that " ' Pulling ' the bines of hills affected with the ' mosaic ' does not appear, therefore, to be of any practical use in dealing with the disease."

The interesting evidence suggesting that one of the new Seedlings, M.45, which appears immune to this disease, may itself be a carrier of it, is presented. During the past season, the disease seems to have considerably abated in our gardens, only thirty hills requiring to be grubbed. It is therefore to be hoped that our method of grubbing infected hills as soon as they are observed, and of propagating only from clean stock, are beginning to show results.

Each year the figures given of the actual and estimated yields of the new varieties become more valuable for two reasons. It is now possible to compare these with the yield of commercial varieties growing side by side. It is also getting safer to strike an average yield for the new Seedlings now that they have cropped for five or more consecutive seasons.

Several of Mr. Salmon's varieties, P.13 and OD.8, M.45, B.7, OF.27, and Y.86 head the list of Earlies and Lates in the Judges' valuation table. In actual resin content " a considerable number (eight) of the new varieties, proved to contain more than 15 per cent. total resins, an amount well in excess of that produced by any commercial variety in cultivation in this country."

One new variety (OF.27) actually produced 18.5 per cent. total resins, " an increase of 4.67 per cent. of resins over the richest commercial variety tested."

(b) Manurial Trials.

The two acres of hops planted with the Tutsham variety with a view to testing :—

i. Possible substitutes for Dung amongst the organic manures.

ii. The value of different forms of Phosphatic manures, have now received two applications of the various dressings, and two crops have been taken. Records of the number of bushels (green) and of the dried weight of hops from each plot (duplicated) so far show practically no difference of consequence.

The acre devoted to different quantities and forms of potash manures will only receive its second application this Spring, so that it is too early days to look for results as yet.

We were able to deal most satisfactorily with the drying of our total growth this year in our own Oast House.

FIELD TRIALS.

It was a distinct encouragement to those of us who had always given considerable time and attention to our field trials to learn that a remark let fall in the last Annual Report, as to the decreasing land available, had been received with disapproval. The remark was really intended to foreshadow the ultimate need for more land if these trials were to be properly maintained and even developed.

Though the larger single areas inevitably get broken up as the work develops, other areas, formerly occupied with such things as nursery work, or where some experiment has been brought to a conclusion, become available for cropping with corn and roots in their turn.

In some ways the facing of these smaller areas has both been good for us and for the conduct of the field trials, for it is now universally admitted by the authorities that small unit plots oft reduplicated give much more accurate results of yields, etc., than the large single unit plots.

For the first time this Autumn we made a great advance in the methods of laying out our Winter Oat and Wheat trials. The different varieties are now growing side by side in drill wide plots repeated several times over. This may necessitate harvesting by hand, but we feel satisfied that our results will be much more reliable. We hope to develop these methods year by year.

The Oat Variety Trials and the Potato Variety Trials carried out in the past season have already been fully reported on in the Journal of the Kent Farmers' Union.

The Winter Oat Trials included the new White Winter Oat Marvellous for the first time. Trials were also made of dressing the seed with Formalin against Smut, but last season no Smut appeared either on the treated or untreated plots.

Another feature of the season's corn trials were the satisfactory yields.

The Potato Trials included, for the first time, an experiment designed to illustrate the results of using cut seed, treated in different ways, as against whole sets. The results have already been reported upon.

The Potato spraying trials have now been carried on for six years, and are being continued for a further four.

In the past Autumn some six acres were drilled with varieties of Winter Oats and Wheat—the latter included the new wheat "Rector."

Ground has also been reserved for the continuation of the Potato Spraying and Variety trials, the value of subsoiling on the Potato crop under our conditions, and for a trial of market peas and beet.

SOME PROBLEMS OF PROPAGATION.

By R. G. Hatton, J. Amos and A. W. Witt.

PART I.

It may be said that all the earlier years' work upon our Root Stock investigations, up to the point when the budded trees began to manifest differences resulting from selected roots, might be summarised in this article.

Aspects of the subject, such as the varieties of rootstock in use, the sources of their origin and raising, the confusion in their nomenclature, the intermixture of named varieties, the most obvious ways of identification, and the best methods for removing inequalities and for standardising rootstocks, have, however, already been more or less exhaustively dealt with from time to time. This account will therefore review the problems directly concerned with the actual methods of raising our Fruit Trees and bushes—the nursery operations. Whilst it is perhaps best to deal with the subject in the chronological order in which our minds would follow out the problem, this does not necessarily mean that this is the order in which we obtained our experimental results.

Methods of Reproduction.

Of the two possible means of propagating fruit trees, only one, the vegetative method, is here considered. In order to reproduce, true to the parent, named varieties of the vast majority of our tree fruits and rootstocks, some form of cutting or layer suggests itself, in the light of present knowledge, as the surest method of attaining our end. Immediately we start sowing seed, we set working all the complicated factors of inheritance, and, until we have learned to control and guide these, this cheap method of reproduction is barred to us so long as we are striving for complete uniformity.

Therefore, whilst we are in a position to answer this first query that enters our minds as to why named varieties are not raised from seed, the ground to some extent still requires clearing

with regard to the actual methods of vegetative reproduction most commonly in use, i.e., the budding or grafting of the named variety upon a distinct root stock, before we can deal with detailed methods and results. Why are not our named varieties of cultivated fruit trees in general reproduced vegetatively by direct methods? Why is it only in exceptional cases that these varieties are raised directly from cuttings, layers, or suckers?

A. FRUIT TREES ON THEIR OWN ROOTS.

So far as our experiments have gone with Apples, they seem to afford two quite reasonable answers to the question as to why the great majority of our named fruit trees are not raised upon their own roots.

The first suggestion is that they are generally not easily so raised by the quickest and most used methods of vegetative propagation (i.e., layers or cuttings).

The Case of Apples.

Although we started as early as 1914 to try and induce named varieties of apple to send out adventitious roots, by various methods of layering, it was not until 1920 that our efforts really met with any success.

Results of Layering.

Whilst the so-called "Paradise" root stocks from the first showed some response to the ordinary crude methods of "stooling," (i.e., the cutting down of the parent plant to ground level, and the earthing up of the subsequent annual growths), the named varieties of apple, in the main the so-called "Codlin" group, which we have specially selected for the purpose because tradition said they were known to take root, did not give a sign of rooting until we had learnt by experience to adopt a special method of "layering," (i.e., the laying down upon the soil of the stronger branches, the cutting in of the weaker side shoots, and the earthing over of the whole prostrated plant). Once this method was adopted, we attained a certain measure of success. Indeed, we anticipate, with the majority of varieties, being able, in a normal season, to provide ourselves with a sufficient unit of rooted layers for experimental material, but our layering method, which

is certainly the most successful we have yet tried, rarely gives us more than twenty per cent. rooted shoots, as against eighty per cent. or ninety per cent. which we can normally obtain with the majority of our root stock types. The following table gives some indication of the sort of variation we have obtained with our material since we subjected single plants to our layering methods in the winter of 1918-19.

Variety.	*No. of rooted layers from single plant.*			*Nature of rooting.*
	1920.	1921	1922	
Lord Suffield	—	—	—	has never rooted.
Lord Grosvenor	—	4	2	poor.
Keswick Codlin	—	10	13	well rooted.
Manx Codlin	—	10	12	fairly well rooted.
Oslin	10	20	27	very free rooting.
Stubbard	—	—	—	has never rooted.
Early Victoria	a few rooted	18	23	poor.
Lord Derby	a few rooted	25	45	well rooted.

With the possible exception of Oslin, none of the above named varieties have so far rooted quite as readily, or in anything like the same percentage, as any of our root stocks, though in the early years of "Stooling," a stock like Doucin (Malling Type II.) would have been classed with these as a shy and spare rooting variety.

A large number of other named varieties of Apple are under similar treatment for various reasons, and several of these are worth mention. Northern Spy, so often recommended Overseas as a root stock because of its immunity to Woolly Aphis, and so often raised by round-about laborious methods, gives us about seventy-five per cent. rooted shoots each year from layer beds. Winter Majetin, Transparent de Croncels and Ben Davis have also shown signs that they can be rooted by such methods.

Since we have not experienced the slowness or cumbersomeness of layering which weighs so heavily upon the Americans, we are for the present continuing these methods, where we require varieties upon their own roots. As the table giving the measurements of our own rooted trees shows, a quite creditable maiden whip is produced in exactly the same time as a budded tree,

(approximately two seasons from the time the rooted plant reaches the Nursery row).

We have not succeeded in doing this so quickly by any other direct vegetative methods.

Results of Hardwood Cuttings.

Since up to the winter of 1920 we received so little encouragement from layering named varieties of Apples, and since we have succeeded in raising many of our varieties of so-called " Paradise " comparatively successfully from cuttings, we determined in the Autumn of 1919 to try ordinary hardwood cuttings of the current season's growth. Accordingly twenty cuttings, about eight inches long, of twenty-one varieties were planted in the Autumn in an open frame, in the ordinary Research Station soil, but with sand at the base of the cuttings.

These varieties included Keswick Codlin, Manx Codlin, Lord Derby and Early Victoria, (four of those we later proved capable of rooting from layers), as well as most of the widely used commercial sorts. A good proportion of all these cuttings got as far as " callusing " well at the base. They then started into leaf, and, except for two cuttings of Manx Codlin, they all failed to send out roots, and died off.

In the same frame were six cuttings of a seedling Apple selected for its promising layering capacity ; all these six cuttings rooted well under the same conditions.

Since we were fortunate enough in 1920 to interest Dr. Knight of the Plant Physiological Department of the Imperial College of Science in this question of recalcitrant cuttings, the possible causes of difficulty, and the methods of accelerating rooting, these experiments have been continued by him and will be reported on at a later date. Suffice it to say that, at the moment, this method did not seem worth pursuing until some light had been shed upon it from the laboratory.

" Nurse Root " Grafting.

Until we received from Amherst, Mass., U.S.A., Dr. J. Shaw's bulletin upon " The Propagation of Apple Trees on their own Roots " in 1920, the American method of using " Nurse " Roots, or " Piece " Roots, upon which to " nurse," by grafting, the variety ultimately desired on its own roots, had not occurred to us.

The variety required on its own roots is thus bench grafted

with an extra long scion, and is then planted deeply, in the hope of inducing the scion itself to send out roots. If and when it does root, it is severed from the "nurse" root, and the variety is obtained upon its own roots. But upon Shaw's own showing, under favourable conditions, this process takes at least two seasons, and then, when the "nurse" root is cut away, the tree sometimes receives a shock from which it but slowly recovers. Hence, in the main, we have persevered with our layering methods, though we have now tried two small experiments with "Nurse" Roots. In the spring of 1922 Mr. E. A. Burgess, the Horticultural Superintendent to the Surrey County Council, very kindly sent me a specimen one-year-old bench grafted Bramley's Seedling; the maiden was about eighteen inches in growth, but what interested me intensely was to see that from the portion of the Bramley's scion, which had been buried below ground, a single strong root had grown out. Further enquiry showed that this was apparently an isolated instance, so in February of both 1922 and 1923 small batches of Bramley's Seedling were grafted at East Malling on to "Nurse" Roots. Of the 1922 batch, two out of four plants showed slight signs of rooting two years after the operation; the 1923 batch shows no rooting at the end of one year. Ten scions of Stubbard (one of our most obstinate subjects), were also "Nurse" root grafted in 1922, but have given no indication of rooting to date. The possibilities of this method are being more fully explored.

Root Cuttings.

Finally, once a variety has been established on its own roots, the possibility of multiplying it from root cuttings at once becomes obvious. In the case of Apple root stocks, some varieties grew much more readily than others from small bits of root, some five inches long, dibbled into the soil just below ground level. The same is likely to happen with cultivated varieties. So far, we have specimens of Lord Derby and Cox's Orange Pippin actually growing from root cuttings of "own root" trees, but none of them could be called robust trees.

Subsequent Behaviour of Trees Grown on their Own Roots.

A second reason why fruit trees are not generally raised upon their own roots is probably that, at any rate in the early years, such trees appear to develop slowly.

No. 2. Typical Manx Codlin Trees. *From left to right:* Growing on its own roots, budded on semi-dwarfing Type II., and budded upon Vigorous Type XV. Note relative vigour.

At one time or another, most of us have seen creditable looking trees of many varieties, which are claimed as being grown on their own roots, but there is surprisingly little evidence as to how they got there and how long they have taken in developing. The early behaviour of our "own root" trees is so consistent that it suggests at least a period of slow development, such as is not apparent on trees budded on vigorous root stocks.

Now, our sets of young trees have been very carefully prepared, with the aim of obtaining strictly comparable trees upon known stocks and upon their own roots at the same time. After several less successful attempts, we adopted the following plan. We chose representatives of both very vigorous and dwarfing forms of "paradise" Stocks, and, at one and the same time, one year rooted shoots of these and of the self-rooted varieties were planted out together in the nursery. All were tipped back at planting. As far as possible comparable rooted layers were selected. When the budding season came round, the "paradise" stocks received the bud of the required variety, but the self-rooted material of that variety naturally remained unbudded. The following Spring, however, when the budded stocks were "snagged" (i.e. cut hard back to where the bud was inserted), the self-rooted material similarly was cut hard back. Thus all the material started at one and the same time to make its true maiden growth.

The following table gives the average weight and height at planting of the 1922 series of these maiden trees. The unit is six trees in nearly every case.

Weight of Maiden.	*On semi-dwarfing Root Stock. II.*	*On own Roots.*	*On vigorous Root Stock. XV.*
	oz.	oz.	oz.
Oslin	6.8	4.8	9.7
Keswick	6.5	3.3	8.5
Manx	6.1	2.8	7.
Early Victoria	7.7	2.8	10.

Height of Maiden.	*On semi-dwarfing Root Stock. II.*	*On own Roots.*	*On vigorous Root Stock. XV.*
	cm.	cm.	cm.
Oslin	77.8	74.6	98.3
Keswick	87.1	74.3	100.6
Manx	70.7	53.	76.1
Early Victoria	81.8	63.3	95.6

If any doubt is felt as to the advisability of making deductions from averages, a glance at the following table of individual weights and measurements of one of our varieties, taken at random, should dispel it. Now that we are working with material which can be controlled to a very considerable degree, our task has certainly become a much easier one, and we can feel all the more confidence in our measurable results.

Manx Codlin on own Roots.		*On Root Stock II.*		*On Root Stock XV.*	
Weight. oz.	*Height.* cm.	*Weight.* oz.	*Height.* cm.	*Weight.* oz.	*Height.* cm.
5	60	7	69	6	72
3	55	4	62	5	70
2	46	6	68	8	78
2	53	7	75	8	82
2	51	6	72	7	80
—	—	6	73	8	75
—	—	7	76	—	—

It will be noted that, in all four varieties, the own rooted trees are the lightest and shortest. This cannot be entirely explained by the fact that the "own root" trees were invariably the worst rooted at the start, because neither Type II. nor XV. are amongst the freest rooting of our layered stocks in the early stages. Again, Oslin, quite a ready rooting variety, falls into line with the other varieties in slow early development upon its own roots.

Similar figures for a series of Lord Derby trees, planted a year earlier, again seem to emphasise the slow growth development of the variety on its own roots, though in the case of the new wood growth, the "own root" trees are ahead of those on the semi-dwarfing Type II. roots. This is interesting, as many growers have long said that Lord Derby was especially susceptible to check in growth if worked on certain "Paradise."

The average weights of the Maiden Trees were :—

On Semi-Dwarfing II.	*On own roots.*	*On Vigorous Types.* *XV.*	*XIII.*	*On Seedlings.*
3.7 oz.	3.6 oz.	8 oz.	7.1 oz.	7.2 oz.

The measurements of the two-year-old growths are as follows :

On II.	*On own Roots.*	*On XV.*	*On XIII.*	*On Seedlings.*
53.7 cm.	63.7 cm.	110 cm.	96.7 cm.	92.6 cm.

We have also other sets of trees of Lord Derby and Early Victoria which have now made four years growth and manifest very much the same relationship, but we do not want to lay too much store by these older trees as they are not so strictly comparable. The next few years will be a most interesting period in the development of these young trees.

In a report of progress like this, we have purposely refrained from elaborating upon what horticultural tradition, literature and peculiar local practice has to contribute to this subject. We are aware that there is considerable material to work upon, but we should be very grateful for any information and references that growers and others care to furnish.

The Case of Plums upon their own Roots.

The case of Plums upon their own roots is rather a different one, for whilst it is very much the exception to find Apples growing upon their own roots, it is the rule to find certain varieties of plums so grown.

That there are a considerable number of plums, in the main those of local origin and culture, quite regularly reproduced from the suckers arising from the roots of older trees is quite well known. Close study in most fruitgrowing districts would probably reveal at least one such variety, but even then the fact remains that these cases are in a minority, and that the general commercial method of raising plums is no artificial adaptation of this method. Nevertheless, there is ample evidence that certain varieties of plum lend themselves to ready propagation from suckers, and they must therefore be fairly free rooting. Plums are, however, far more widely raised by budding and grafting upon distinct root stocks and not by the artificial creation of rooted suckers. That it is quite possible to do this latter successfully on a commercial scale, with many local varieties, we have demonstrated. Varieties like Magnum Bonum, Warwick Drooper and Bastard Victoria produced as many as ninety per cent. rooted layers. Even the less free rooting varieties, such as Pershore Egg and Blaisden Red, give from forty to seventy per cent. rooted layers according to seasonal conditions. If there was much demand for these varieties on their own roots, systematic layering would be a necessity, both because a supply of chance suckers is an uncertain source, and the trees from such suckers are not always the most presentable. That these methods of propagation can be applied even to varieties such as Victoria and Czar we have also tested, but until we know more of the behaviour of varieties grown upon their own roots, as compared with the behaviour of the same varieties grown upon distinct root-stocks, we have no particular reason to recommend it. From a good rooted sucker, we obtain a good three to six foot maiden in exactly the same time as it takes us to get a similar budded one. We therefore do not save time. Whether we gain in the ultimate performance of the tree, its health, cropping capabilities or vigour, our experiments are designed to elucidate. So far our data is insufficient to give much indication, even in the case of vigour of growth.

Let us consider our youngest sets of trees first, since they are the most carefully designed for comparison, in that both root and stem portions of all the trees are precisely the same age, and have undergone precisely the same treatment, except for the omission of the insertion of the bud in the " own root " trees.

The following table gives the average lengths of the maiden growth on units of about fifteen trees of each certain varieties grown upon their own roots and worked upon the Common Mussel Stock. In general, we have not found this stock to furnish very vigorous trees in the early years. It is what we should call an "intermediate" stock. Had we required to get really vigorous maidens, we should have used a Myrobolan Stock, or possibly Brompton Stock, according to variety. In five out of the eight varieties the budded trees appear to be making slightly more rapid growth.

Average height in feet and inches of Maiden Plums

	(*a*) On Own Roots.	(*b*) On Common Mussel Stock.
Pershore Egg	4′ 3″	5′
White Magnum Bonum	4′	3′ 11″
Warwickshire Drooper	4′ 5″	3′ 9″
Cambridge Gage	3′ 2″	3′ 11″
Blaisden Red	5′	4′ 7″
Bastard Victoria	4′ 3″	4′ 9″
Bastard Orleans	3′ 6″	4′ 7″
Kea Plum	3′ 7″	4′ 1″

A single season's results, however, should be taken with caution. The average growth measurements of a series of four year old Pershore Egg Plums upon their own roots and worked upon various root systems would seem to show, in that particular instance at any rate, that the trees on their own roots are holding their own in vigour even against trees worked on Myrobolan, though curiously enough they are not quite so vigorous as trees budded upon Pershore roots.

Owing to the inequality of the incidence of Silverleaf, however, upon these older trees, and its greater frequency amongst trees on certain stocks, it is felt that this work must be repeated before deductions can safely be drawn.

(*To be continued*).

SOME FACTORS INFLUENCING ROOT DEVELOPMENT.

By R. G. Hatton, N. H. Grubb and J. Amos.

As soon as our Stock Trial experiments began to indicate measurable effects upon the scion of different root-stocks, it became evident that it would be of value to explore some of these factors which might tend to mask root-stock influence. These factors would naturally include the reciprocal effect of the Scion upon the root-stock, any treatment which the root itself might receive at planting, such as selective root pruning, condition of soil at the time of planting as affecting moisture and aeration, and the effect of branch pruning upon root development.

Experiments along all these lines have been in progress for longer or shorter periods, and, in several cases, have already been reduplicated once or twice. Although results do not yet justify definite conclusions, the early indications give abundant evidence that these questions cannot be ignored, and that they call for much more intensive investigation. Our programme of work for the next few years includes items designed to shed further light upon these aspects.

1. Effect of Scion on Root.

Our early efforts to trace scion effects upon the root, based as they were upon a general examination of large numbers of young trees lifted from the nursery, seemed to show that any such effect was purely quantitative.

A small experiment designed to test, by actual figures, these impressions of the eye, yielded a definite confirmation. Comparable stocks of the French Paradise (Malling Type VIII.) were budded with scions of Bramley's Seedling and Stirling Castle. Five maiden trees of each were carefully lifted, the tops and roots were weighed separately and finally the roots were graded. Whilst the average total weight of the Bramley trees (214 grams) was just over double that of the Stirling trees (105 grams), the weight of roots of the Bramley trees (40 grams) was just under double that

of the Stirling trees (21 grams). The general character of the roots in all cases was quite typical of French Paradise (Malling Type VIII.), and the effect on the Scion, as compared with other root-stocks, was that of comparative dwarfingness. The definite grading of the roots into "coarse" and "fibrous" showed no measurable influence of the scion. Roughly the percentage of fibrous roots in each case was twenty-five per cent.

This method of root analysis seemed so promising that it was decided to apply it to certain batches of trees which appeared on close examination to be, as usual, remarkably uniform in root characters.

The first series of trees to which such an analysis was applied was a set consisting of two-year-old Tyler's Kernel and Lord Derby on three distinct root systems (Malling Types I., II. and IV.). The varieties were especially selected as being traditionally supposed to alter root character. Pickering stated (see "Science and Fruit Growing," page 332), that some varieties such as "Tyler's Kernel, when grown on the Paradise stock, alter the habits of the roots to such an extent that they assume the deep rooting and straggling character of the Crab stock" (!). Lord Derby, on the other hand, is commonly reputed in the nursery trade to make all types of root more fibrous. Our root stocks were also particularly chosen for the purpose; Type I. because unworked it presented a well mixed balance of coarse root and fibre; Type II. because fibre is always notably scanty; and Type IV. because of its horizontal rootedness.

In digging up the trees no differences could be observed in the depths of the root sustems worked with the two varieties, but in all cases the Tyler's Kernel were the most vigorous trees, and again illustrated by actual weight the quantative effect upon the roots already mentioned. When the roots were graded it was found that there was actually a measurable difference in the proportion of the finer more fibrous roots. The following figures show the average weight of the fibrous roots as a percentage of the total roots. The unit of trees used was 9 or 10 in each case.

On Stock.	Type I.	II.	IV.
Tyler's Kernel ..	30.5%	13%	19% Fibre.
Lord Derby ..	36%	18%	24% Fibre.

These figures are the result of a single experiment which has

not yet been repeated, and since four trees of each variety on Malling Type V. indicated a slight difference in the reverse direction, too much weight must not be attached to them by themselves. However, a further series of Maiden trees on two root-stocks, Malling Type II. (little fibre), and Malling Type VI. (well balanced mixture of coarse and fibrous roots), was subjected to a similar analysis. All the trees in these experiments were lifted most carefully, so that they might be examined with their root systems intact, as far as possible. Lord Derby was again included in this series and showed the same tendency as before to produce abundant fibre. The following figures show the position.

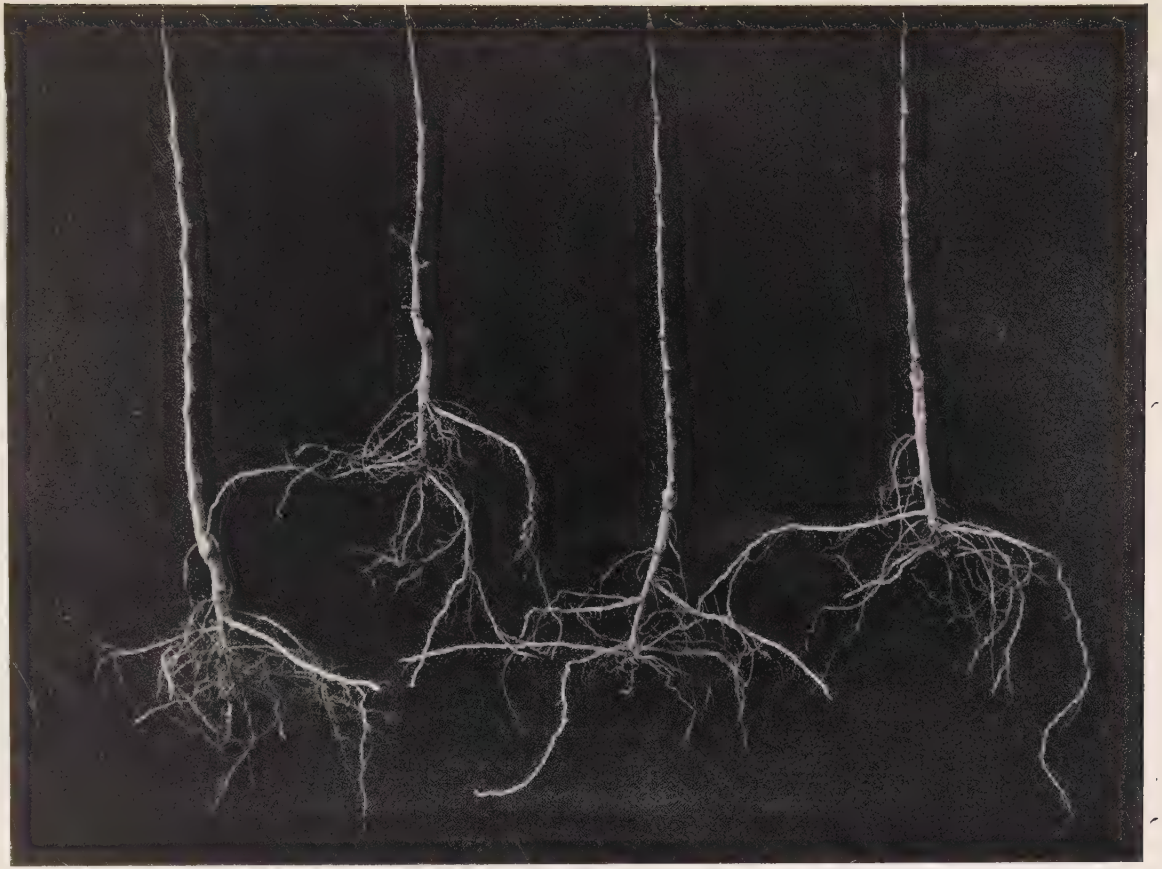
On Stock.	Type II.	Type VI.
Grenadier	13.4%	36.9% Fibre.
Newton Wonder ..	15.4%	38.9%
Lord Derby ..	18.1%	57.1%
Beauty of Bath ..	18.2%	59.3%

It will be noticed from these figures that the most fibrous maidens on Type II. are, in proportion of fibre, still far behind the least fibrous rooted on Type VI. In other words, though different scions may have different effects upon the same root-stock, these seem to be, up to this age, subordinate to the general root character.

So far the relative proportions of " fibre " and " coarse " roots have been considered, but there are two other aspects both of which insistently suggest the need for further work upon these lines in collaboration with a physiologist. The first is the proportion of the total weight of the tree represented by roots. In three out of the four varieties mentioned above the total weight of roots as a percentage of the whole tree very closely approximate. The fourth variety, Grenadier, shows on each stock a much higher proportion of roots to the whole tree. The following figures show the position.

Weight of Roots as Percentage of whole tree.

On Stock	Type II.	Type VI.
Newton Wonder ..	19.2%	12.7%
Beauty of Bath ..	22.1%	14.5%
Lord Derby ..	22.9%	14.4%
Grenadier	31.3%	26.4%



No. 3. Typical maidens of (*from left*) Grenadier, Lord Derby, Beauty of Bath and Newton Wonder, all budded upon Type II. There appears to the eye no striking influence of scion upon root

No 4. Typical maidens of Grenadier, Beauty of Bath and Newton Wonder, all budded upon Type VI.

When the weights of each class of root are carefully reviewed it appears that the very high percentage for Grenadier is mainly due to an increase of coarse roots and not fibre. On the other hand, the slightly lower percentages for Newton Wonder are mainly due to a decrease in fibre. Thus some further light is thrown upon the low proportion of fibre already shown in the case of these two varieties.

Secondly there is the question of the depth below ground level of the chief part of this root development as affected by scion. The length of the stock below ground (i.e., underground portion of stem from which the roots have arisen adventitiously), was, for purposes of analysis, divided into two equal portions (roughly 10 cm. each). Very fortunately this length below ground proved remarkably regular. Generally speaking, by far the greatest bulk of roots came from the bottom area (from 10 to 20 cm. below ground level but within the whole range of the underground stem the area of the main root activity was exceedingly variable. There was, however, one striking exception, where with greater uniformity than usual, more than half the roots came from the top area. This was in the case of Grenadier, which showed this characteristic strikingly when budded upon Type VI. Whether this is a constant characteristic further examinations will show.

2. The Effect of Branch Pruning upon Root Development.

Our object in initiating these experiments was to discover how far, if at all, the pruning of the stem would reflect itself upon the root system. We have as yet only one season's results to chronicle, but the material was extremely carefully graded for uniformity, and the results of different treatments were so consistently striking and suggestive that they appear worth discussion.

Moreover these early indications seem to fall into line with the recently published results of Dr. W. H. Chandler, of Cornell University Agricultural Experiment Station, N.Y. (Bulletin 415, "Results of Some Experiments in Pruning Fruit Trees," Jan., 1923).

The material used for the experiment was unworked one and two year old apple root-stocks of Malling Type X. These stocks were divided into four units of forty stocks each, each unit containing an almost exactly similar gradation of stocks from large to small

All the Stocks were completely shaved of their roots, and were then weighed, the weight of each individual being recorded. The stocks were then uniformly planted in a single row, each unit in two different places.

The following treatments were subsequently given :—

Series A. Stem and branches untouched.
Series B. Half the length above ground cut away, before growth began.
Series C Cut down to ground level, before growth began.
Series D. Cut down in July, (i.) to 6 inches above ground.
(ii.) to 12 inches above ground.

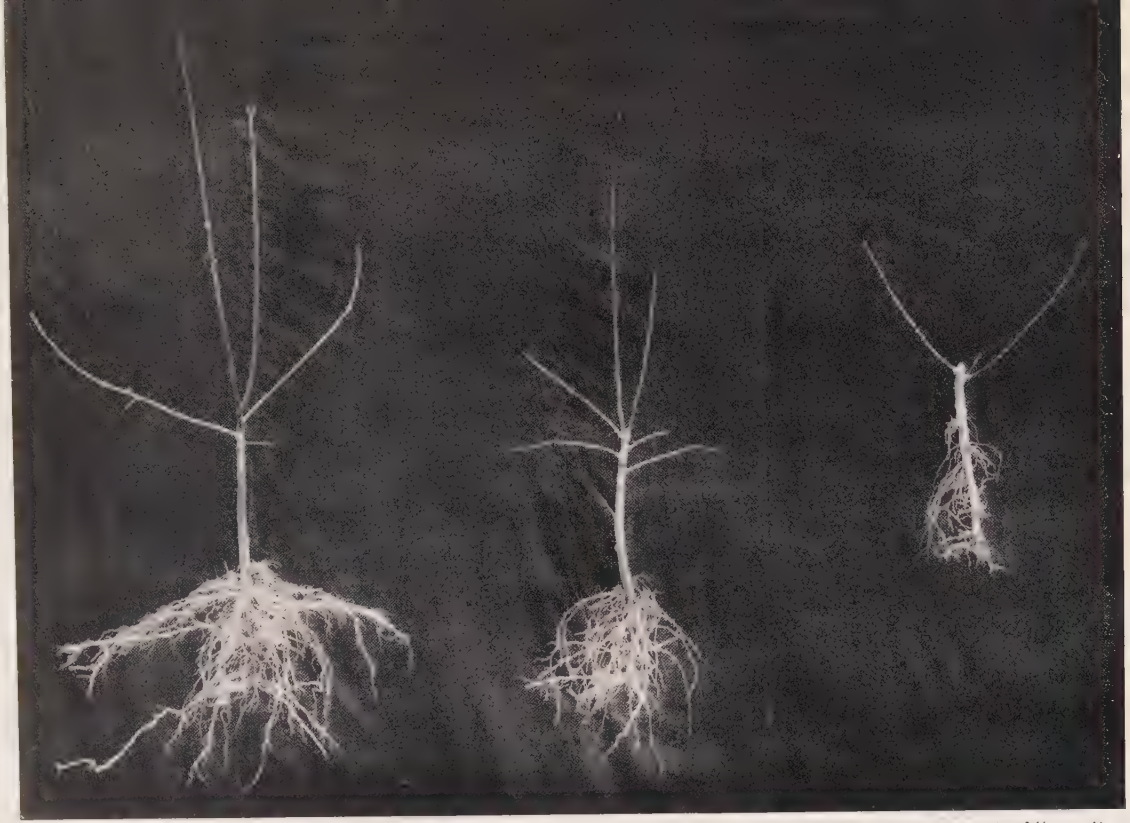
Half the stocks included in each series have been dug this winter. They were reweighed and the new woodgrowth and roots weighed separately and the latter analysed. The results of series A to C might be first compared. They are slightly more striking in the case of the two year old material, for which the figures are given below :—

	Coarse roots. (over 3 mm.)	Fibrous roots. (under 3 mm.)	New wood growth.
Series A. untouched	14 gms.	20 gms.	8 gms.
Series B. cut half back	6 gms.	11 gms.	29 gms.
Series C. cut to ground	1.5 gm.	7 gms.	16 gms.

The figures on the one year old material very generally bear out the above results. Whilst the untouched tree, at least in the first season, appears to put most of its energy into root development, the pruned tree seems to make new wood growth at the expense of early root development. It is impossible to forecast how far these differences will tend to disappear after another year's growth, or whether they may be accentuated ; or again, whether the same differences would have appeared if the stocks had been allowed to establish themselves for a year before being treated.

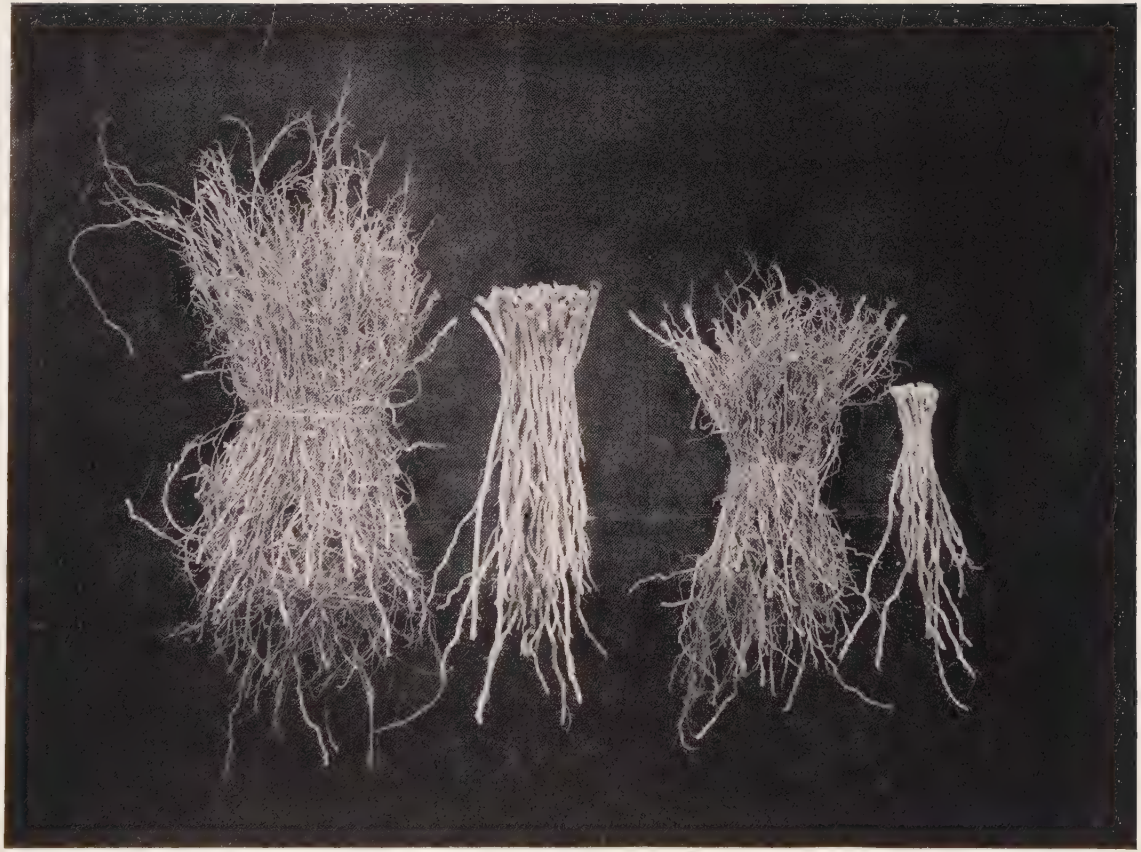
Series D was designed to give some preliminary evidence upon the effect of summer pruning. Up to July 6th these stocks had the same opportunities of root and top growth as Series A. They were then divided into two sub-series :—

(i.) Cut down to within 6 inches of ground level.
(ii.) Cut down to within 12 inches of ground level.



No. 5. Typical effects upon root development and new growth resulting from different treatment of " top " at time of planting.

(*From left*) Stem untouched. Ample root development and little new growth in proportion.
Stem cut half away. Root development checked and proportionately vigorous growth.
Stem cut to ground level. Root development poor and comparatively vigorous growth.



No. 6. On left fibrous roots and coarse roots from ten untouched stocks ; on right similar roots from ten cut to ground level at time of planting.

It should be pointed out that these were both very drastic treatments considering the season of the year. It was at once evident above ground that the plants recognised this, for the few remaining leaves immediately showed a browning and shrivelling at the margin, which frequently spread quickly over the whole leaf surface. Within a few weeks, however, new growth began. With regard to the effects upon the root, the whole of this summer pruned series showed a considerable reduction in both coarse and fibrous roots as compared with Series A. The chief reduction was in the case of coarse roots. The harder the stocks were cut back, the more they showed this reduction.

It will be obvious that these very suggestive indications may prove to have a wide economic application with regard to the whole question of pruning, both summer and winter; but it is most inadvisable that any such conclusions should be forced until these experiments have been much further elaborated.

3 Root Treatments before Planting—Selective Root Pruning.

It was hoped, through these series of experiments, which have now been repeated in one form or another for three successive seasons, to find out, through field trials, something about the development and functions of the different types of root upon a single root system. Series of trees upon known root systems have been subjected to various root treatments, and then, after one or two seasons' growth, have been lifted, examined and later weighed and analysed.

Series A. has been carefully lifted from the Nursery with all roots intact.

Series B. has had all the fibrous roots stripped off and all the coarse roots left.

Series C. has had all the coarse roots cut away and only the fibrous roots left.

Series D. has had all the roots cut clean away close to the main "underground stem," and has been replanted with virtually no roots. This method has come to be known as the "Stringfellow" method, in memory of its most strenuous advocate. All trees in these series were immediately replanted after treatment.

A further series, E., has had the roots subjected to considerable exposure to drying agencies, before replanting.

The outstanding feature of our experiments has been the confirmation in a modified form of the oft-repeated assertion that, after removal from the Nursery and replanting, the young tree has practically to start afresh in its root making. The most striking fact has been the wonderful development of roots in a single season upon Series D. (all roots cut away).

It has been said that all the fibrous roots die, as a result of disturbance, and have to start entirely anew. This has certainly not been the case in our experiments, though the continued activity of the old fibre, which was quite easily recognised as dark in colour and adpressed to the stem as a result of the act of planting was generally of minor importance. That it is still capable of development into coarse roots was shown when comparison was made of Series C. (minus coarse roots), and Series D. (all roots cut away), the former showing a distinctly greater proportion of " coarse " roots.

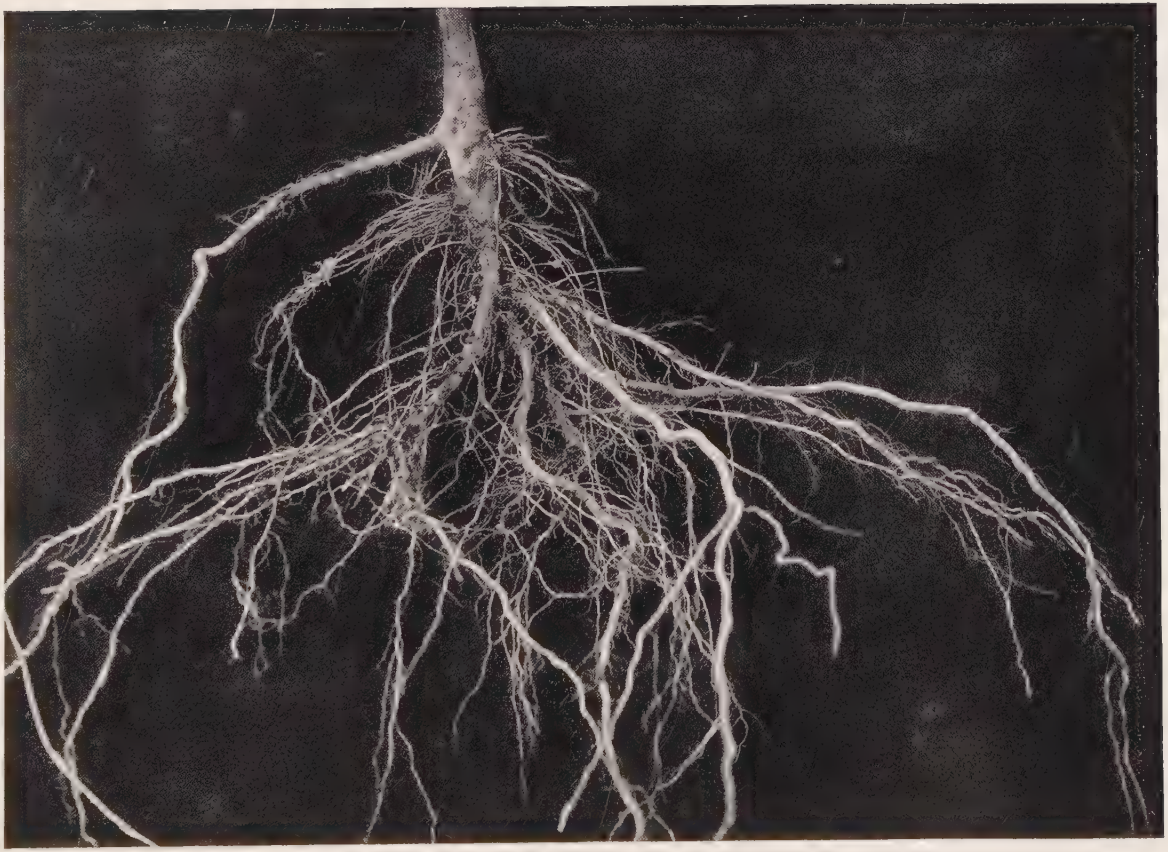
The " coarse " roots, as observed in these experiments, most certainly did not die when left normally upon the tree. In general, they increased in diameter ; they afforded a main source from which new adventitious roots developed, not only from the extreme tips, but from other areas ; and there is evidence, in the general behaviour of the trees, that the retention of these roots had a distinct value for wood growth.

The results from Series E. (roots exposed and dried), therefore, need little comment, especially since our drying process not infrequently caused some actual shrivelling of the stem portion of the tree.

In view of the fact that this series of experiments is to some extent complimentary to those already detailed concerning the effect of branch pruning upon root development, it appears worthwhile to contrast the effect upon branch development of the different degrees of root pruning practised in this series.

The cutting off of the fibre has reduced the subsequent wood growth very little ; whilst the cutting off of the coarse roots has checked it considerably. The cutting off of all roots has still further checked it, though it has never proved fatal to the tree. The following figures show the effects of the various root

No. 7. Root of Broadleaf (Type I), two years after replanting with roots untouched. (Series A.)



No. 8. Root of Broadleaf (Type I.) two years after replanting, with all fibre cut off. (Series B.)
Note similarity to No. 9.

treatments on three series of trees, so treated in successional seasons.

Table showing amount of new growth made.

	Lane P.A. on Type I.	Worcester P. on Type V	Worcester P. on Type I.
Series A. untouched	82 cm.	82	93
Series B. minus fibre	96	80	(no trees so treated).
Series C. minus coarse	69	63	69
Series D. Stringfellow	62	57	64

If it be possible, at this stage, to make any comment upon these two series of experiments dealing with the effects of degrees of branch and root pruning respectively, it would be merely to point out that the root pruning has had less effect in reducing the formation of new roots and wood than has the branch pruning.

4. Effect of Various Conditions of Soil Moisture and Aeration.

Trials in the field have been designed to see how far it was possible to influence the development of known varieties of roots by different method and conditions of planting. First, different methods have been employed for preparing the soil to receive the roots. For instance, double dug plots are being compared with plots where the sub-soil has been rammed to create a "pan," with ordinary ploughed or dug land as a control. Secondly, certain trees have been "rammed" at planting, whilst others have been merely lightly trodden in. Finally, trees upon a known root system have been planted at widely differing depths in the same soil.

No measurable results have so far become apparent as a result of the different treatments of the soil, or of the different methods of making the tree firm. Something however might be said from two points of view about the last series of trials, involving trees planted at different depths.

The first point is the effect on the roots. One series of trees consists of the variety Bramley's Seedling, worked upon Malling Type VI. The following treatments have been given to different batches :—

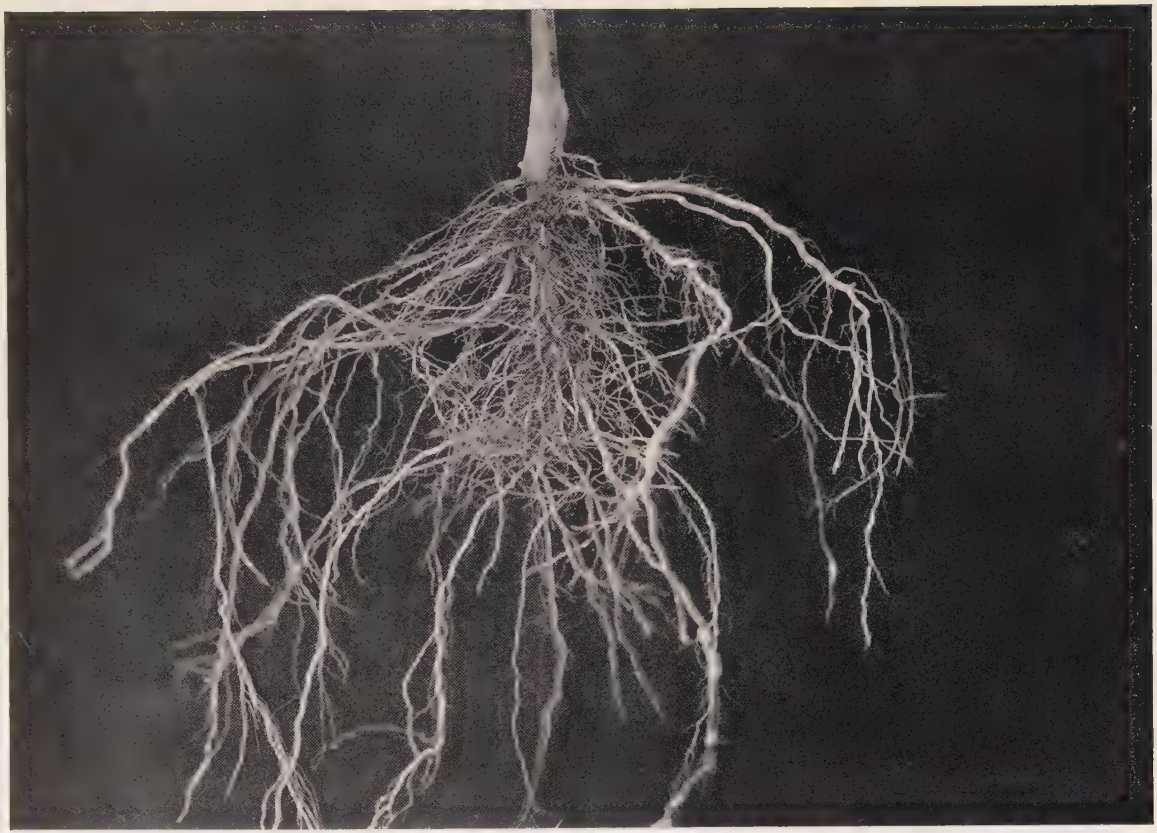
1. Planted on the surface and mounded up.
2. Planted with "union" just covered.

3. Planted with "union" 6 inches below ground.
4. Planted with "union" 12 inches below ground.
5. Planted with "union" 18 inches below ground.
6. Planted with "union" 24 inches below ground.

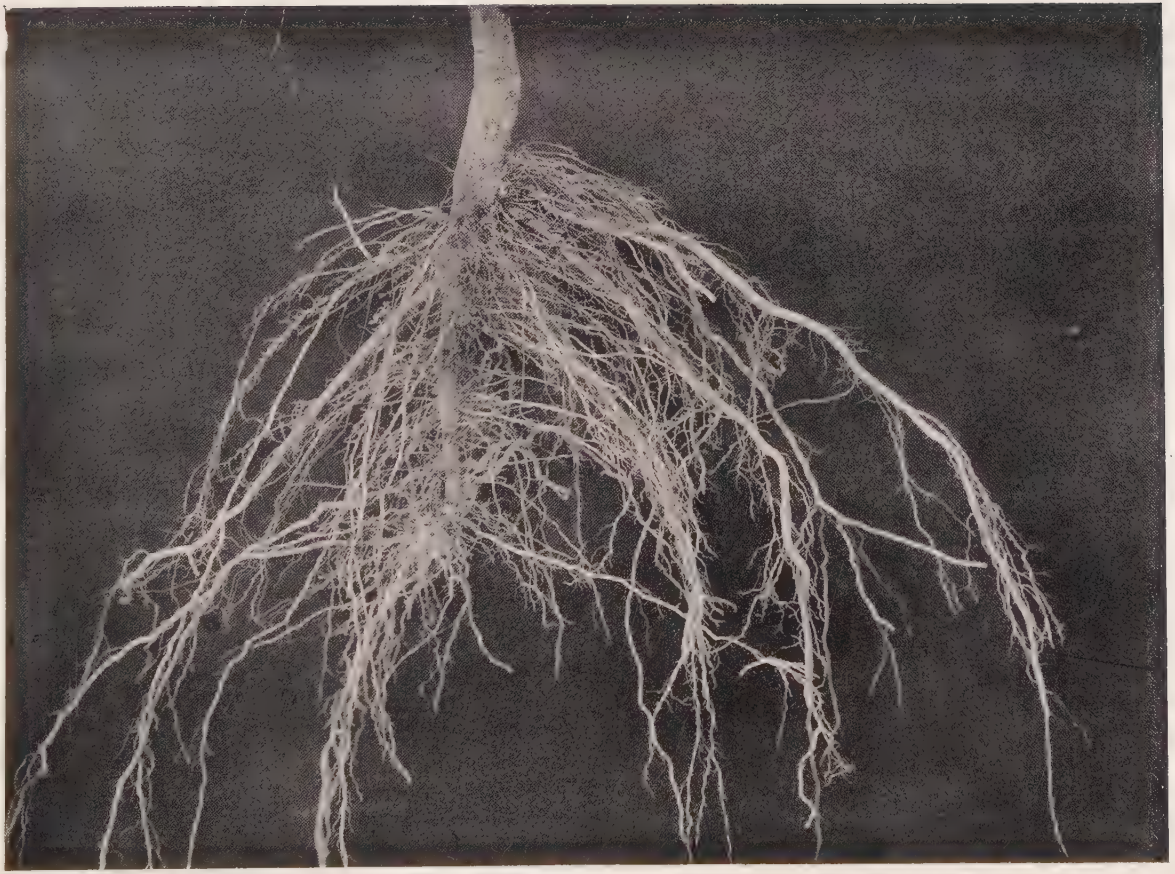
The main object of this experiment was to follow the development of the roots upon the different areas of the under-ground stem of the stock, and to see whether, eventually, by deep planting, the root system would be forced to develop upon the buried area of the scion itself. Six trees, scattered in a single row, were, as a preliminary, subjected to each treatment. Only two of each have been lifted in the past season, to give some indication of what is happening. Although, as has been pointed out elsewhere, this development of the roots upon a particular area of the stock is, under our conditions, somewhat variable, these first results have given a fairly constant indication of what might have been expected to happen. The deeper the tree is planted the more marked becomes the tendency for the main development of the root to shift upwards, though so far the scion itself has not been induced to send up roots. As far as growth is concerned, there is little to be seen except in the poorer growth of those trees planted on the surface.

This second point—the effect of the depth of planting on the growth of the tree—has been studied on other series of Bramley's Seedlings on three root stocks, Malling Types VIII., V. and III. Here the difference in the depth of planting of the trees was slight, i.e., between the complete exposure of the union of stock and scion, and its covering to the depth of three inches. The indications from this series of trees, are, first, that the result depends to some extent on the variety of root stock. For instance, the shallow planted trees on the very dwarfing stock, Malling Type VIII., did not in the first four years get into normal growth as compared with the deep planted trees on the same stock; whereas on both the other root stocks, the shallow planted trees, though behind at first, nearly or quite caught up to the deep planted trees in growth in the same period.

The second indication is that seasonal variations affect the result. Thus, the shallow planted trees received a much more distinct check than the deep planted trees in the dry summer of 1921; and there is at least a suggestion that when the drought



No. 9. Root of Broadleaf (Type I.) two years after replanting, with all coarse roots cut off. (Series C.)
Note roots are less coarse than on Nos. 9 and 10.



No. 10. Root of Broadleaf (Type I.) two years after replanting, with all roots cut away. "Stringfellowed." (Series E.) Note rapid new development.

was broken in the following summer, the rain helped the shallow planted sooner than the deep planted trees.

There is also an indication that the check to growth caused by shallow planting tended slightly to increase fruit bud formation.

Two other minor points are worth mention. The tradition that planting the tree with the union well covered will prevent the formation of a "bulge" at the union is by no means consistently borne out by these trees; on Types VIII. and III. the bulge was actually larger on the deep planted trees, whilst in Type V. the reverse was the case. We have had other evidence that covering the union does not prevent the formation of a "bulge," but merely puts it out of sight.

Finally the four or five inches difference in depth of planting gave an obvious demonstration of the better anchorage of the deeper planted trees.

In considering all these results regarding depths of planting, it should be remembered that our soil is a lightish loam over Kentish rag; and that where these experiments were carried out, the rag stone nowhere came within three feet of the surface. On badly drained and badly aerated soils the burying of the root stock two feet deep might in all probability have killed the tree outright; whereas in our case no very striking results appeared during the first season.

Whilst those who sign this article have all been concerned in the designing and execution of these experiments, the burden of recording has fallen more to the lot of some, and that of analysing and weighing up the results to others. At the same time, we all realise that without the meticulous care and enthusiasm of our assistant recorders, the mass of minute data from which these deductions are drawn could not have been secured.

8. FUNGICIDAL SPRAYING OF APPLES.

By N. H. Grubb and N. B. Bagenal.

The first year's work under the joint programme arranged with Mr. Salmon and Dr. Goodwin of the S.E.A. College, Wye, mentioned in the last Report, has now been completed. The programme was in part directed towards checking the results obtained in the previous work on fungicides (as far as this is concerned, the 1923 results are discussed in a report just issued); but several new features have been introduced, particularly the testing of "delayed dormant" fungicide sprays, applied at winter strength as late as is considered safe before blossoming. The trees used for the purpose are bush trees of Worcester Pearmain some twelve years old, kindly lent us by Mr. W. H. Tolhurst, of Ditton Court Farm.

Effect on Scab.

The amount of Scab was carefully noted, on the leaves on June 26th, and on the fruit at picking time. The marks given to indicate the scab infections on the leaves were based on an estimate of each tree separately, allowance being made in each case for the proportion of leaves showing scab, and the degree of infection of those that showed it. The results agree closely enough with the proportion of scabbed fruit observed at picking time to be considered fairly trustworthy; the two series of observations will here be considered together.

The ten trees not sprayed either before or after blossoming produced on the average over twenty per cent. of scabbed fruit. This was checked by twelve trees which were sprayed once (June 7th), with "dry mix sulphur lime"; the sulphur used was too coarse for the purpose and was mostly left in the spray tank. Here the proportion of scabbed fruit was almost exactly the same as from the unsprayed trees. The trees in both groups showed a considerable leaf infection on June 26th, more on the average than those of any other group.

Four groups of ten trees each were sprayed only on April 20th, several days before the first blossoms opened; the fungicides used were Lime Sulphur at 1 to 19, and Bordeaux 10-10-100, in each case alone on one group, and with Lead Arsenate at 4 lbs. per 100 gallons on another group. The scab was noticeably less on both leaves and fruit of all four groups than on the trees left unsprayed; the worst of them, those sprayed with Lime Sulphur at 1 to 19 alone, produced less than nine per cent. of scabbed fruit (unsprayed trees over twenty per cent., see above). The trees sprayed with Lime Sulphur 1 to 19 with Lead Arsenate had considerably less scab on both leaves and fruit than those sprayed with lime sulphur alone; whilst those sprayed with Bordeaux with Lead Arsenate had slightly less scab on the leaves, and slightly more on the fruit, than those sprayed with Bordeaux alone.

Five groups of ten trees each (not sprayed before blossoming) were sprayed on May 17th, immediately after the blossom fell, and again on June 7th. The fungicides used here were Lime Sulphur at 1 to 29, and at 1 to 99, in each case alone, on one group, and with Lead Arsenate at 4 lbs. to 100 gallons, on another group. The fifth group was sprayed with Bordeaux at 8-8-100 (without Lead Arsenate). The scab was very much reduced on both leaves and fruit by Lime Sulphur at 1 to 29 (with and without Lead Arsenate) and by Bordeaux; it was considerably reduced by the weak Lime Sulphur (1 to 99) with lead Arsenate, but less so where no Arsenate was added. The latter group (without Arsenate) produced nearly thirteen per cent. of scabbed fruits, and the leaves were nearly as much scabbed as those of the unsprayed trees; where Arsenate was added, on the other hand, the scabbed fruit was reduced to just over eight per cent., and the leaves were little more scabbed, on the average, than those of the trees sprayed before blossoming, though much more so than those of the other groups sprayed after blossoming.

It thus appears that scab may be at least partially controlled by a single application of fungicides before blossoming, or by Lime Sulphur at 1 to 99, with Lead Arsenate, applied twice after blossoming. The trees used in the experiment, as the figures for the unsprayed trees show, were only moderately infected with scab in 1923; in a year of severe infection it is doubtful whether these applications would be enough to save the bulk of the crop in a marketable condition.

Effect on Yield of Fruit.

Previous experiments carried on here have shown that Lime Sulphur applied to apple trees after blossoming is apt to cause a heavy drop of the small fruit. These observations are fully corroborated by the current year's work, and additional observations of considerable interest have been made.

The number of blossom buds on each tree was recorded at the end of April. An attempt was made to record the dropped fruits before the second (after blossom) spraying (June 7th); but the fruits were then so small that the attempt proved to be hopeless. A record of the fruits which dropped after the second spraying was made on July 9th. At this time the normal July drop was practically complete, and the dropping of properly "set" fruits due to wind, had begun. The dropped fruits affected by sawfly were recorded separately.

That the application of Lime Sulphur at 1 to 29 after blossoming did reduce the crop is shown by the percentage of blossom which produced mature fruit. This figure was, for the unsprayed trees, 16.9 per cent., and for those sprayed with Lime Sulphur at 1 to 29 (alone) after blossoming, 11.4 per cent. The weaker Lime Sulphur (1 to 99) applied alone after blossoming caused little, if any, fruit drop; the percentage of blossom "setting" was actually higher than on the unsprayed trees, 18.2 per cent. The same was true of all the spray mixtures used before blossoming. The Bordeaux mixture applied after blossoming (8-8-100) appeared, for the first time in our experience, to cause a considerable fruit drop; the percentage of blossom "set" where it was used was 12.6 per cent. (unsprayed 16.9 per cent.). Whether this was due to some peculiarity of the season, or to an accidental choice of trees which would have given a similar result even if unsprayed, cannot be determined. The whole series of tests is to be repeated; it seems hardly likely that a similar result will occur again.

The effect of the addition of Lead Arsenate to the fungicides was very striking. The trees sprayed before blossoming in each case showed a higher percentage of blossom set where Lead Arsenate was added than where it was not; the same is true, and the difference is considerably greater, in the case of the trees sprayed after blossoming. There is no reason to doubt that

almost the whole of this effect of Lead Arsenate is in both cases its insecticidal action ; but the insects concerned are not the same in the two cases. The figures show beyond a doubt that the application of Lead Arsenate after blossoming greatly reduced the number of fruits injured by sawfly ; this was not the case where Arsenate was used before blossoming. The figures are worth presenting in a table :—

CONTROL OF APPLE SAWFLY BY LEAD ARSENATE.

	Aver. No. of Injured Fruits per Tree.	*As % of Blossom Buds.*
Before blossoming.		
1. Lime Sulphur 1 to 19 alone	51	12.6
2. Lime Sulphur 1 to 19, with Lead Arsenate	64	15.6
3. Bordeaux, 10-10-100 alone	74	16.2
4. Bordeaux, 10-10-100, with Lead Arsenate	90	23.6
After blossoming.		
5. Lime Sulphur, 1 to 29 alone	44	12.8
6. Ditto with Lead Arsenate	15	3.7
7. Lime Sulphur, 1 to 99 alone	61	12.9
8. Ditto with Lead Arsenate	20	4.9
9. Bordeaux 8-8-100 alone	45	11.2
10. Dry Mix Sulphur Lime (once sprayed)	74	—
11. Unsprayed	69	16.7

The figures do not show the whole effect of the Arsenate. When the injured fruits were counted it was noticed that, where Arsenate had been used after blossoming, the proportion of injured fruits actually entered by the sawfly larvæ was very small, whilst on the other trees a majority had been entered. Unfortunately, no record was made of this difference.

A comparison of the figures for the unsprayed trees with those for the trees sprayed with Lime Sulphur, and Bordeaux without Lead Arsenate, suggests that these sprays also may have slightly reduced the sawfly attack. It is at least conceivable that where a few trees in a large plantation are sprayed with these mixtures

the adult sawflies might prefer other trees for egg laying. But that will hardly account for the striking difference produced by the Lead Arsenate. One can hardly escape the conclusion that the young larvae, before penetrating the fruits, consumed enough Arsenate to kill them.

Effect on size of Fruit.

The fungicides applied after blossoming appear to have had little if any influence on the average size of the fruit. Considerable differences do occur, but they are closely connected with the average crop borne by the trees; those that cropped most heavily bore the smallest fruit, and vice versa.

But the fungicides applied before blossoming, or at least the Bordeaux, do appear to have had some effect. The differences do not accompany differences in cropping; for the trees sprayed (before blossoming) with Lime Sulphur plus Lead Arsenate produced a much heavier crop of slightly larger fruit than those sprayed with Lime Sulphur alone. But in these two cases the size of the fruit was not much different from that of the unsprayed trees. The trees sprayed (before blossoming) with Bordeaux, however, produced the largest fruit (on the average) of all the groups in the trial. And since they bore a heavier crop than all groups sprayed after blossoming except one (i.e., the trees sprayed with Lime Sulphur at 1 to 99 plus Lead Arsenate), it seems possible that the Bordeaux did actually increase the size of the fruit. It is noticeable that the trees sprayed with the Bordeaux after blossoming also produced larger fruit than those of any other group, except those just mentioned, but they bore so light a crop that the large fruit might well be ascribed to this factor above.

THE CONTROL OF BIG BUD MITE
(*Eriophys Ribis*, Nal.)
IN THE FIELD.

By H. M. Tydeman.

Although until recently the Station had no resident entomologist, methods of controlling Big Bud mite in the field became a matter of imperative study owing to our other Black Currant experiments. In the winter of 1921-22 systematic investigations into the efficacy, under local conditions, of some of the methods of control suggested at one time or another, were commenced upon a plot of Baldwins some acre in extent, and laid down for this purpose in 1920. At the time of the inauguration of these experiments the bushes were two years old, interplanted between apple trees, and were divided into eight plots each containing ninety-seven bushes ; each method of treatment being duplicated in order to obviate, as far as possible, differences attributable to soil and position. All the plots received the same manurial and cultural treatment and the three following methods of control were tested in comparison with untreated bushes :—

Plots 1 and 8 : all Big Buds hand picked during the Winter.

Plots 2 and 7 : Bushes sprayed with Lime Sulphur at Winter strength. (1-12) towards the end of March while the leaves were still quite small. This is the treatment suggested by Mr. A. H. Lees of Long Ashton, in the Annual Report, Agricultural and Horticultural Research Station, Long Ashton, 1919. Plots 3 and 6 : odd numbered bushes were cut down to ground level during one winter ; even numbered bushes similarly treated during the following winter.

Plots 4 and 5 untreated " control " rows.

At the time of commencing these experiments the bushes, which had been procured from an ordinary commercial course, had a

few "Big Buds" fairly evenly distributed between the plots, as the following table shows :—

Plots		*Bushes infected*	*Total number of "Big Buds"*
1 and 8	Hand Picked	7	21
2 and 7	Lime Sulphur	5	12
3 and 6	Cut Down	7	21
4 and 5	Untreated "Controls"	7	22

During the winters of 1921-22 and 1922-23 the treatments stated were made and the appended table shows the results of examinations in the winters of 1922-23 and 1923-24 :—

Plot		1922-23			1923-24		
		Bushes infected	*Total Number of "Big Buds"*	*Total Number of Bushes*	*Bushes infected*	*Total Number of "Big Buds"*	*Total Number of Bushes*
1 and 8	Hand-picked	37	113	185	137	380	185
2 and 7	Lime Sulphur	26	45	180	110	244	177
3 and 6	Alternate bushes cut down	45	178	177	145	835	174
4 and 5	Untreated controls	47	229	174	163	2458	172

To summarise these results, it is apparent that while no particular method of control has given us completely satisfactory results, we have been able, by the use of Lime Sulphur in early Spring, to reduce the severity of the attacks. While hand-picking has proved a good second in point of success, possibly the labour involved, especially where large units of bushes are concerned, might militate against its utility on an extensive scale. Our third treatment, that of cutting down alternate bushes has not under our conditions given so large a measure of control and has also the obvious disadvantage that only half the number of bushes are cropping in any one season. For instance, the plots used for Lime Sulphur treatment, comprising 177 healthy bushes, gave a total crop of 4 cwts, 37 lbs. or an average of 2 lbs. 11 ozs.

per bush in 1923 ; whilst the plots used for alternate year cutting down treatment, comprising 174 healthy bushes, only half of which were in their cropping year, yielded a crop of 2 cwts. 46 lbs. or an average of 1 lb. 8 ozs. per bush. If, however, we reckon the average crop on these latter plots only upon the bushes in actual cropping in 1923, they yielded 2 lbs. 13 ozs. per bush on a single season's wood growth as compared with 2 lbs. 11 ozs. per bush on bushes with four years' growth of wood.

In the present incomplete state of scientific knowledge upon the subject of " Reversion " in Black Currants it is perhaps premature to assume any direct relationship between this trouble and the incidence of " Big Bud." Nevertheless it has been thought best, in order to eliminate this unknown factor, to exclude from the figures so far given in this account, all bushes known to be affected by " Reversion."

The commercial strain of Baldwins purchased for this study had from the start considerable tendency to " revert," and, from an early stage, it became clear that the plots destined for Lime Sulphur treatment were especially severely affected. It would therefore be unwise to assume that the Lime Sulphur treatment has had anything to do with this development.

All bushes have been recorded for " Reversion " on blossom characters in April and May and on leaf characters in June and July each year. The " reverted " bushes were allowed to remain and were recorded separately for " Big Bud." Whilst generally speaking, " Big Bud " developed much more rapidly on the " reverted " bushes than on the others, up to the second year there were four out of nineteen severely reverted bushes and twenty-two out of forty-one bushes in earlier stages of " reversion " showing on apparent " Big Bud." Even at the present time three of the thirty-nine bushes in the early stages of " reversion " show no " Big Bud," though all the thirty-nine severely affected bushes now show it. When one takes the average number of " Big Buds " per " reverted " bush, even here the Lime Sulphur and hand-picking treatments show rather fewer, though neither method has been capable of stemming the rapid increase of the mite upon these " reverts."

Thanks are due to Mr. A. M. Massee for assistance in checking the " Big Bud " counts and to Mr. J. Amos for the early records of the bushes.

RASPBERRY INVESTIGATIONS.

By N. H. Grubb.

The progress made in 1923 in the work with raspberries, whilst not sufficient to justify the issue of a detailed report, is of enough interest to warrant a short descriptive article here. In addition to the original work on the classification of varieties, and their nomenclature, other lines are being developed. The testing of the economic value of the more important varieties is being pursued and preparations made, in collaboration with Long Ashton, for trials on a variety of soils. Cultural work has also been begun, and preparations made for its development in several directions.

(*a*) *The Classification and Naming of Varieties.*

New varieties are still being added to the collection, partly by exchange with Long Ashton, and partly by purchase of canes advertised under names represented incorrectly or not at all in our collection. If named varieties which have been isolated as rogues from other sorts are included, the collection now contains some 100 varieties of summer fruiting red raspberries.

The correct names of certain doubtful varieties are gradually being obtained. Thus the variety described in "Commercial Raspberries and their Classification" under the name "Baumforth's Seedling B" is probably the original "Northumberland Fillbasket"; it was received from a grower who had had it under this name for very many years.

It also seems probable that the variety described in our report as "Fillbasket A" is correctly "Fastolf"; it appears now to be identical with a variety received as "Fastolf," and also with a variety received as "Filby Seedling," a name given by Hogg as a synonym for Fastolf. Samples received under two or three other names are also very similar to this, and may be identical with it.

(*b*) *Yield Trials.*

Although the extended trials on a variety of soils arranged in conjunction with Long Ashton cannot be begun until more material is available, the weight of fruit produced by all varieties in bearing here is recorded each year; each lot of a variety planted in more than one place is recorded separately.

Only ten varieties have cropped here for more than one year. Of these, Pyne's Royal, for the fourth year in succession, produced the heaviest yield; it was followed in 1923 by Norwich Wonder, and Baumforth's Seedling B. For the third season out of the last four, Bath's Perfection cropped very poorly; of the ten varieties only one, Park Lane, gave a smaller yield in 1923.

Some thirty varieties fruited for the first time in 1923. Of these, Lloyd George led in weight of crop, followed by Red Cross, Helston (two lots received from the same grower under different names), and Baumforth's Seedling A. All these yielded more than Pyne's Royal or Baumforth's Seedling B of the same age. A very small lot of Red Magnum Bonum actually yielded more than any other but Lloyd George; but without further trial, one cannot give much weight to a result obtained from so few plants.

The highest yield (Lloyd George), was over ten times as great as the lowest (one of the numerous "Red Antwerps"). In spite of this great difference between varieties, different samples of the same variety were never very far apart in yield.

(*c*) *Cultural Trials.*

Four varieties, planted on both manured and unmanured land, gave their first crop in 1923. The manured land received moderate dressings of dung and shoddy in alternate years, and has had spring dressings of fish or meat meal in addition. The unmanured land has received nothing since 1918-19, except crops of green manure in 1921 and 1922.

The growth of canes on these two plots in 1922 showed that the difference in cropping was likely to be less in some cases than might have been expected. Thus Baumforth's Seedling B. produced about twenty per cent. more cane on the manured land, but the canes were slightly taller on the average on the unmanured land. In the case of Pyne's Royal, there was nearly 300 per cent.

more cane, and the canes were six inches taller, on the manured land.

In 1923 Baumforth's Seedling B. actually produced about twenty per cent. more fruit on the *unmanured* land than on the manured; Devon also gave about seven per cent. more on the *unmanured*; whilst Pyne's Royal gave nearly 170 per cent. more on the *manured* land. Of Bath's Perfection the crop was practically the same on each plot, and would not have been worth picking commercially.

The most surprising result here is the behaviour of Devon. This variety has always appeared so sensitive to drought that we expected a much heavier crop on the manured land. The result with Baumforth's Seedling B. may perhaps be in some way connected with the fact, referred to on another page, that the "mosaic" disease was much more prominent on this variety where growing on manured land. It may be added that these results are based on considerable lengths of row: two rows each of Baumforth's Seedling B. and Devon, on each plot, and one of Pyne's Royal, each row being 360 feet long.

RASPBERRY "MOSAIC."

By N. H. Grubb and A. M. Massee.

American work on Raspberry "Mosaic," indicating as it does that the disease known under this name in America may cause serious losses to raspberry growers, has led to the initiation here of a study of the mosaic appearance common on raspberries in this country. That this condition is very widespread is indicated by its appearance in raspberries received here from every part of England, in a few samples from Scotland, in one from Ireland, and in two or three from the Continent. Whilst it cannot yet be said that the various types of mottled foliage seen in different varieties of raspberries are all due to one cause, it may be definitely stated that signs of mottling have been seen in every variety, except a few recently raised seedlings sent here for trial. That this is not mainly due to the plants having become affected since they were received, is shown by the fact that several samples have been growing in our soil for three years surrounded by plants with mottled foliage, without as yet showing a trace of mosaic.

On the other hand, it now seems very probable that the mosaic is spreading to some extent amongst our plants. In each of the last two years, a considerable number of seedlings has been raised, in one case from seed taken from plants particularly badly affected by mosaic. At first none of the seedlings showed any trace of mottled foliage; yet, by the end of the Summer of 1923, several of the two-year-old seedlings, and two or three even of the yearlings, showed typical cases of mosaic. None of these occurred in the seedlings raised from seed from badly affected plants.

There are now several reasons for thinking that the mosaic so common in this country is distinct from that described by American pathologists. The American disease is described as being fatal to the plant within two or three years; yet in this

country cases are known of apparent recovery of plants formerly very badly affected by mosaic ; and it is clear that the condition may persist for several years without killing the plant, or even preventing it from bearing good crops of fruit. And there is no sign in our plants of the dry seedy fruit produced by plants recently infected, which is said to be universal in America.

Further, in America, the point at which a cane was infected can be plainly seen ; all leaves below this point are normal, while those above it show typical mosaic. This condition is seldom if ever seen in plants showing typical mosaic here. (There are probably other diseases of raspberries in this country which do show a definite point of infection, but they are quite distinct from the common mosaic.) On the other hand, we frequently find canes bearing mottled leaves all up one side, and normal leaves on the other side ; often a part of one leaf is mottled and the rest normal. This condition was shown to Dr. C. R. Shear, of Washington, who has studied American mosaic closely ; he had not seen anything resembling it in America.

Then again, European varieties are found in America to be largely resistant, and in some cases immune, to mosaic. The only American variety which we have studied, Marlborough (i.e., Bath's Perfection) while not immune to our mosaic, appears to be more resistant than most of our own varieties.

Finally, the agent which is now known to spread raspberry mosaic in America, Aphis rubiphila Patch, has never been reported in this country. It may, of course, occur here ; but were it responsible for the spread of a condition so common as our mosaic, it could hardly have been overlooked.

Some of our observations suggest that raspberry mosaic is in some way connected with soil conditions. Thus " Baumforth's Seedling B.", of which some plants show mosaic very clearly, whilst others appear to be entirely free from it (some varieties, such as Hornet A. and Norwich Wonder, show signs of mosaic in every plant), has this year shown a relatively large number of canes with mottled foliage on the manured plot, and very few on the unmanured plot. It cannot yet be said, of course, that the manure is responsible for this result ; but it seems difficult to account for it in any other way. As noted on an earlier page, the manured plot receives dung and shoddy in alternate years, and has had spring dressings of fish or meat meal since the

raspberries were planted two years ago. Any or all of these applications might be concerned in the result.

This work on mosaic is being continued with a variety of material. Further batches of seedlings are being raised with a view to controlled attempts to produce mottled foliage in them. At the same time, observations are being made to determine whether the mosaic appears in successive seasons on the same plants, or whether plants affected in one season may appear normal in the next, and vice versa.

LIST OF PUBLISHED REPORTS.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
POMOLOGY.		
Top Fruits.		
Paradise Apple Stocks. By R. G. Hatton, M.A., 1917.	Journal of Royal Horticultural Society, Vol. xlii., Part 2 and 3, p. 361, September, 1917.	Reprints now exhausted.
Paradise Apple Stocks (Fruit and Blossom). By R. G. Hatton, M.A., 1918.	Ditto, Vol. xliv., p. 89, May, 1919.	Ditto.
Summary of the Results obtained in Selecting and Propagating Paradise Stocks. By R. G. Hatton, M. A., 1919.	The Fruit Grower, Vol. xlvii., pp. 1211-1212, February, 1919; Fruit Trades' Journal, Vol. xxxv., Nos. 7, 8, 9, February, 1919; Gardeners' Chronicle, Vol. lxv., Nos. 1677, 1678, 1679, pp. 71, 82, 100, February and March, 1919.	Ditto.
Suggestions for the Right Selection of Apple Stocks. By R. G. Hatton, M.A.	Journal of Royal Horticultural Society, Vol. xlv., Parts 2 and 3, p. 257, July, 1920.	Ditto.
A First Report on Quince Stock for Pears. By R. G. Hatton, M.A., 1920.	Journal of Royal Horticultural Society, Vol. xlv., Parts 2 and 3, p. 269, July, 1920.	Price 6d., postage 2d.
Stocks for the Stone Fruits. By R. G. Hatton, M.A., 1921.	Journal of Pomology, Vol. ii., No. 4, pp. 209-245, August, 1921.	Price 1s. 6d., postage 3d.
Some Notes on Stocks for Plums. By R. G. Hatton, M.A.	Journal of the Kent Farmers' Union, Vol. xiv, No. 5, p. 158, November, 1923.	Price 2d., postage 1d.
The Importance of Suitable Stocks in Planting Young Fruit Trees. By R. G. Hatton, M.A., 1921.	Journal of the Kent Farmers' Union, Vol. x., No. 3, p. 82, September, 1921.	Price 3d., postage 1d.
Results of Researches on Fruit Tree Stocks. By R. G. Hatton, M.A., 1920.	Journal of Pomology, Vol. II., No. 1, pp. 1-10, November, 1920.	Reprints now exhausted.
The Influence of Root Stock upon the Tree Fruits. By R. G. Hatton, M.A.	Fruit Grower, Vol. xvi., No. 1455, pp. 639-641; No. 1456, pp. 699-700; No. 1457, pp. 759-760; 18th and 25th October, 1923, and 1st November, 1923. Verslag Van Het International Tuinvouw-Congress Amsterdam, 17th-23rd September, 1923, pp. 94-117.	Price 6d., postage 2d.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
Progress in Methods of Practical Fruit Growing. By R. G. Hatton, M.A. " Notes for Fruit Growers."	Journal of Royal Agricultural Society of England, Vol. 82, pp. 49-117, 1921. Contributed monthly to Journal of the Kent Farmers' Union and Federation of British Growers' Journal.	To be obtained only from Publishers, John Murray, Albemarle St., London.
Fruit Growing in Small Gardens. I. By R. G. Hatton, M.A.	The Garden, Vol. lxxxviii., No. 2727, pp. 99-100, 23rd February, 1924.	No reprints.
Ditto. II., By R. G. Hatton, M.A.	The Garden, Vol. lxxxviii., No. 2728, pp. 121-122, 1st March, 1924.	Ditto.
Ditto. III., By R. G. Hatton, M.A.	The Garden, Vol. lxxxviii., No. 2729, pp. 145-146, 8th March, 1924.	Ditto.
Ditto. IV., By R. G. Hatton, M.A.	The Garden, Vol. lxxxviii., No. 2730, pp. 162-163, 15th March, 1924.	Ditto.
Ditto. V., By R. G. Hatton, M.A.	The Garden, Vol. lxxxviii., No. 2731, p. 193, 22nd March, 1924.	Ditto.
The Control of the Fruit Tree through its roots. By R. G. Hatton, M.A.	" Country Life," Vol. lv., No. 1430, pp. 867-869. June, 1924.	Ditto.
Small Fruits.		
Black Currant Varieties—A Method of Classification. By R. G. Hatton, M.A., 1920.	Journal of Pomology, Vol. i., Nos. 2 and 3, pp. 65-80-145-154, 1920.	Reprints now exhausted.
The " Running-Off " of Black Currants. By R. Wellington, R. G. Hatton and J. Amos, 1921.	Ditto, Vol. ii., No. 3, pp. 160-198, May, 1921.	Ditto.
Commercial Raspberries and Their Classification. By N. H. Grubb, M.S.A., 1922.	Journal of Pomology and Horticultural Science, Vol. iii., No. 1, pp. 11-35, November, 1922.	Price 7d., postage 3d.
*A Note on the Impurity of Raspberry Stocks By N. H. Grubb and G. S. Peren.	Ditto, Vol. iii., No. 1, pp. 7-10, November, 1922.	No reprints.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
Pruning.		
Results of Apple Pruning Experiments. By N. H. Grubb, M.S.A., 1921.	Journal of the Kent Farmers' Union, Vol. x., No. 4, p. 114, October, 1921.	Price 3d., postage 1d.
Winter Pruning Experiments with Apple Trees. By N. H. Grubb, M.S.A., 1922.	Journal of Royal Horticultural Society, Vol. xlvii., Parts 2 and 3, p. 139, September, 1922.	Price 6d., postage 2d.
Further Notes on Pruning. By N. H. Grubb. M.S.A., 1923.	Journal of the Kent Farmers' Union, Vol. xiii., No. 3, p. 95, March, 1923.	Price 3d., postage 1d.
Pruning Neglected Fruit Trees. By N. H. Grubb and A. W. Witt.	The Garden, Vol. lxxxviii., No. 2726, pp. 88-89, 16th February, 1924.	No reprints.
PATHOLOGY.		
Tests of Fungicides on Apple Trees. By N. H. Grubb, 1921.	Journal of Pomology, Vol. ii., No. 2, pp. 93-114, February, 1921.	Price 6d., postage 3d.
Experiences with Fungicidal Sprays. By N. H. Grubb, M.S.A., 1921.	Journal of the Kent Farmers' Union, Vol. ix., No. 5, p. 147, May, 1921.	No reprints.
†Notes on the Control of Nursery Stock against Crown Gall. By H. Wormald, D.Sc., and N. H. Grubb, M.S.A., 1922.	Gardeners' Chronicle, Vol. lxxi., No. 1843, p. 198, April, 1922	Ditto.
The Spraying of Apples. By N. H. Grubb, M.S.A.	Gardeners' Chronicle, Vol. lxx., No. 1826, p. 326, December, 1921.	Ditto.
Tests of Fungicides on Apple Trees—II. By N. H. Grubb, M.S.A., 1924.	Journal of Pomology, Vol. iii., No. 4, pp. 157-173. January, 1924.	Ditto.
‡The Mulberry Blight in Britain. By H. Wormald, D.Sc.	Annals of Applied Biology, Vol. XI., No. 2, pp. , July, 1924.	Ditto.
*The Crown Gall Disease of Nursery Stocks—I. Field Observations on Apple. By H. Wormald, D.Sc. and N. H. Grubb, M.S.A., Hort. Research Station, East Malling, Kent.	Annals of Applied Biology (in the press), Vol. No. , October, 1924.	Ditto.
Spraying Trials with Potatoes, 1918. By E. S. Salmon and H. Wormald, D.Sc.	Journal of the Board of Agriculture, Vol. xxvi., No. 1, p. 71, April, 1919.	Ditto.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
PATHOLOGY (*con.*).		
Potato Spraying. "Three Years' Results at East Malling Research Station." By R. G. Hatton, M.A., 1921.	Journal of the Kent Farmers' Union, Vol. x., No. 1, p. 8, July, 1921.	No reprints.
ENTOMOLOGY.		
Control of Apple Blossom Weevil. By R. G. Hatton, M.A., 1921.	Journal of the Kent Farmers' Union, Vol. IX., No. 6, p. 176, June, 1921.	Ditto.
Apple Blossom Weevil Experiments. By K. Worsley, 1922.	Journal of the Kent Farmers' Union, Vol. XII., No. 1, p. 30, July, 1922.	Ditto.
The Resistance of Apple Stocks to Attacks of the Green Apple Aphis. By A. M. Massee.	Journal of Pomology, Vol. iii., No. 4, pp. 191-200, January, 1924.	Ditto.
Abnormal Leaves of the Himalaya Berry and the Raspberry. By A. M. Massee.	The Gardeners' Chronicle, Vol. lxxii., No. 1872, p. 281, November 11th, 1922.	Ditto.
The Control of the Apple Blossom Weevil. By A. M. Massee.	Journal of Pomology, Vol. IV., No. 1, pp. 24-37, July, 1924.	Ditto.
The Leaf and Bud Mite of Raspberry. By A. M. Massee.	Journal of Pomology, Vol. IV., No. 1, pp. 59-61, July, 1924.	Ditto
HOPS.		
First Report on Trial of New Varieties of Hops at East Malling. By E. S. Salmon, 1917.	The Research and Advisory Dept., S.E.A. College, Wye, January, 1918.	Reprints now exhausted.
Second Ditto. By E. S. Salmon, 1918.	Ditto, April, 1919.	
Third Ditto. By E. S. Salmon, 1919.	Ditto, April, 1920.	Price 6d., postage 2d.
§Fourth Ditto. By E. S. Salmon, 1920.	East Malling Research Station, Kent, July, 1921.	Ditto.
§Fifth Ditto. By E. S. Salmon, 1921.	Ditto, 1922.	Ditto,
§Sixth Ditto. By E. S. Salmon, 1922.	Ditto, 1923.	Ditto.
§Seventh Ditto. By E. S. Salmon, 1923.	Ditto, 1924.	Ditto.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
FIELD TRIALS.		
Potatoes.		
Variety Trials with Potatoes, 1919-1920. By R. G. Hatton, M.A.	Journal of the Kent Farmers' Union, Vol. ix., No. 1, p. 21, January, 1921.	No reprints.
Ditto, 1921. By J. Amos.	Ditto, Vol. xi., No. 1, p. 20, January, 1922.	Ditto.
Potato Trials at East Malling Research Station, 1923.	Journal of the Kent Farmers' Union, Vol. xiv., No. 5, p. 166, November, 1923.	Ditto.
Corn.		
Variety Trials with Oats and Barley. Spring, 1920. By R. G. Hatton, M.A.	Journal of the Kent Farmers' Union, Vol. viii, No. 6, p. 148, December, 1920.	Ditto.
Wheat Trials at East Malling, 1921. By J. Amos.	Ditto, Vol. x., No. 3, p. 91, September, 1921.	Ditto.
Winter Corn Trials (Wheat and Oats), 1921-22. By J. Amos.	Ditto, Vol. xii., No. 5, p. 164, November, 1922.	Ditto.
Corn and Root Trials (1923-1924). By R. G. Hatton, M.A.	Ditto, Vol. xiv., No. 4, p. 116, October, 1923.	Ditto.
Winter Oat Trials (1922-23). By J. Amos.	Ditto, Vol. xiv., No. 5, p. 165, November, 1923.	Ditto.
METEOROLOGY.		
Meteorolgical Observations.	Contributed monthly to the Kent Farmers' Union Journal.	No reprints.
GENERAL.		
Annual Report.	East Malling Research Station, 1920.	Reprints exhausted.
Ditto.	Ditto, 1921.	Ditto
Ditto.	Ditto, 1922.	Ditto.
Ditto.	Ditto, 1923.	Price 3s., postage 4d.

* Joint Publication with Long Ashton Research Station.
† Joint Publication with South Eastern Agricultural College, Wye, Kent.
‡ This Report was mainly the result of an investigation carried out at the S.E.A. College, Wye, and completed after Dr. Wormald's appointment at East Malling.
§ Reports issued from East Malling by E. S. Salmon, S.E.A. College, Wye, on data collected jointly upon Hops grown at East Malling.